

**REMEDIAL INVESTIGATION AND
FEASIBILITY STUDY**

REMEDIAL INVESTIGATION REPORT

Sutton Brook Disposal Area Superfund Site
Tewksbury, Massachusetts
February 2007



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1. INTRODUCTION

The Sutton Brook Potentially Responsible Party (PRP) Group (the Group) has entered into an Administrative Order by Consent (the Order) with the U.S. Environmental Protection Agency (EPA) to perform a Remedial Investigation (RI) and Feasibility Study (FS) at the Sutton Brook Disposal Area Superfund Site (the Site) (U.S. EPA Region 1 Docket No. CERCLA-01-2004-0002). The Sutton Brook Disposal Area, also referred to as Rocco's Landfill, is located off South Street on the eastern boundary of the Town of Tewksbury, Middlesex County, Massachusetts. A small portion of the Site also extends into the Town of Wilmington. The general location of the Site is presented as Figure 1-1.

Consistent with the Order, a Draft RI/FS Workplan was prepared and submitted to EPA and the Massachusetts Department of Environmental Protection (MassDEP) on June 23, 2004. On July 21, 2004, EPA approved, with conditions, the Draft Workplan. During July and August, comments were reviewed and addressed and a Revised RI/FS Workplan was prepared and submitted to EPA and MassDEP on September 10, 2004.

Field activities associated with the RI (Phase 1A) were initiated in September 2004. Consistent with the Order and schedule of deliverables, following the Phase 1A RI activities, a Draft Phase 1A RI Deliverable was prepared and submitted to EPA and the MassDEP on March 4, 2005. The Phase 1A RI Deliverable was comprised of: an updated Conceptual Site Model; the First Interim Deliverable for the Risk Assessment; a proposed scope for the Phase 1B RI Field Investigation; a Pre-Record of Decision (ROD) Monitoring and Sampling Plan; and an updated RI/FS Schedule.

On August 18, 2005, EPA provided formal comments on the Phase 1A RI Deliverable. On September 16, 2005, a revised Phase 1B RI Workplan was submitted to EPA and field activities associated with the Phase 1B RI were initiated. A response to comments submittal on the Phase 1A RI Deliverable was prepared and submitted to EPA on September 22, 2005. Additional comments on the Phase 1A RI Deliverable, predominantly on the risk assessment, were provided by EPA on January 13, 2006.

The data collected during the Phase 1A and 1B RI was used to develop a Draft Screening Level Ecological Risk Assessment (SLERA), which was submitted to EPA and MassDEP on April 4, 2006, and a Draft RI Report, including a draft human health risk characterization, which was submitted to EPA and MassDEP on April 28, 2006. EPA provided comments on the Draft RI report on July 3, 2006 and responses to these comments were submitted on August 11, 2006 with a comment discussion meeting conducted on September 6, 2006. Responses to issues identified in the September 2006 meeting were submitted to EPA on November 13, 2006 with comments to these responses provided by EPA on November 29, 2006.

EPA provided comments on the Draft SLERA on June 6, 2006 and based on responses to comments and follow-up comments and discussions, a Preliminary Data Refinement (initial steps in the Baseline Ecological Risk Assessment refinement) was submitted on September 19, 2006. Following review of this document by EPA, additional sediment samples were collected in two distinct areas of the site to aid in the ecological risk characterization of the Site. These samples were collected in November 2006. The results and evaluation from these sediment samples were submitted to EPA in December 2006 and January 2007.

During the implementation of the RI, monthly progress reports and conference calls between EPA, MassDEP, and the PRP Group are conducted to discuss project status, resolve any issues, and develop near-term action items and schedules.

In addition, in September 2005 a pre-ROD groundwater monitoring program was initiated with quarterly sampling conducted the first year (September, December, February, and June) followed by semi-annual sampling during the second year (October and April).



The implementation of the RI/FS is an integrated series of steps and/or phases. This integrated process ensures an orderly remedy selection. An updated process diagram for the RI/FS approach, depicting the steps or phases and key milestone dates is presented as Figure 1-2 on the following page. Completed activities are shaded on this figure.

For the purposes of the RI/FS, a preliminary area proposed for investigation was delineated in the RI/FS Workplan, September 10, 2004. This area (with slight modification [expansion of area] from the Workplan figure) is shown on Figure 1-3 and is comprised of properties now or formerly owned by Anthony and Jeanette Rocco, John Cave, the Town of Tewksbury, and Perkins Development Trust. It should be noted that this figure also depicts identified reference locations.

1.1 RI/FS OBJECTIVES

The primary objective of the RI/FS is to assess site conditions and evaluate alternatives to the extent necessary to select a remedy for the Site, as defined in the Order for the RI/FS, U.S. EPA Region 1 Docket No. CERCLA-01-2004-0002.

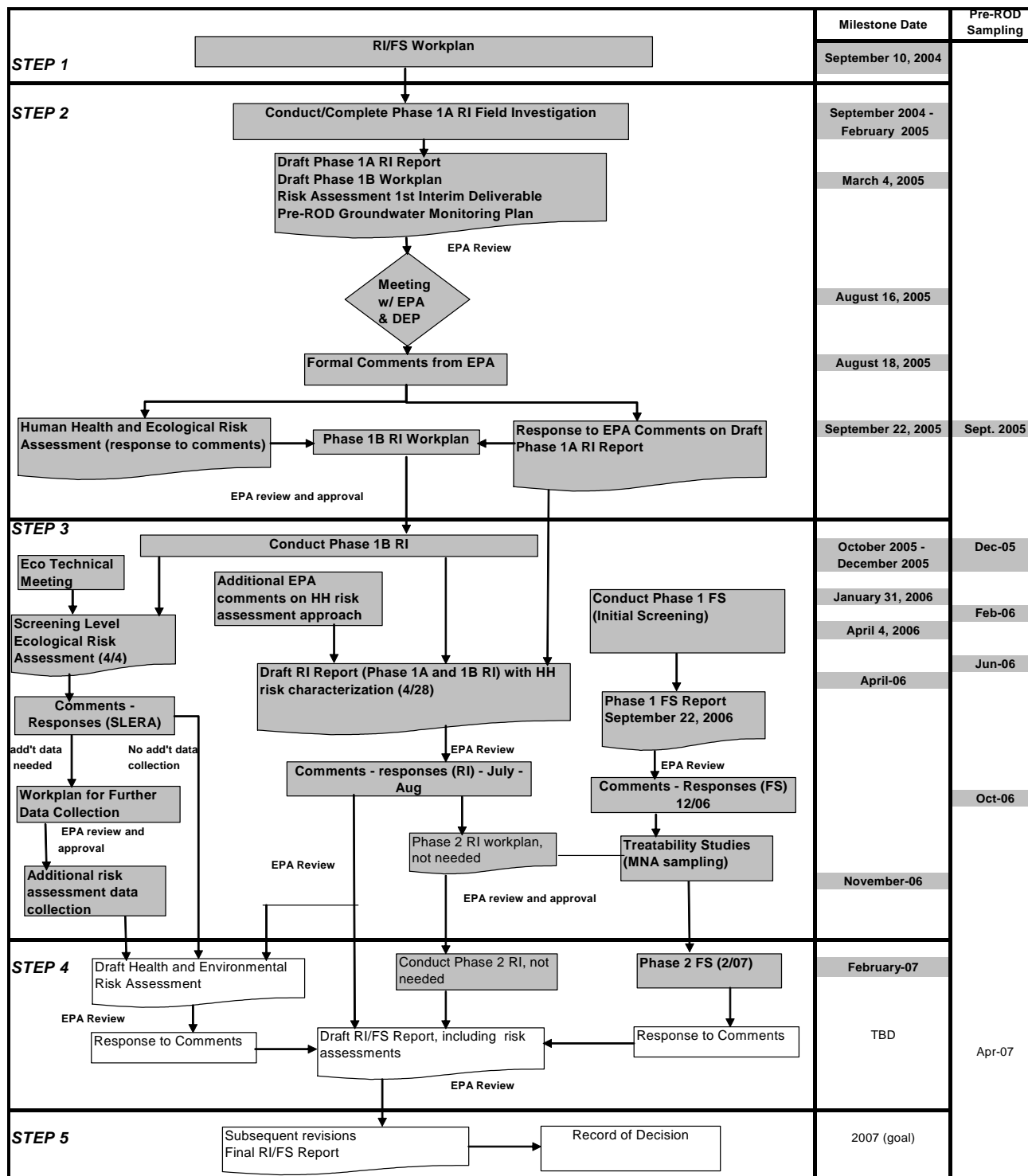
The specific objectives of the RI are to:

- evaluate the source(s), nature, extent, and distribution of contaminants released;
- provide sufficient information to assess the current and future potential risks to human health and to the environment; and
- since capping of the landfill is presumed, provide sufficient information to evaluate a capping system, including innovative technologies and the evaluation of the physical layout of Sutton Brook.



Figure 1-2

REVISED RI/FS MILESTONE SCHEDULE – SUTTON BROOK DISPOSAL AREA SUPERFUND SITE – TEWKSBURY, MASSACHUSETTS



Shaded cells indicate milestones complete.



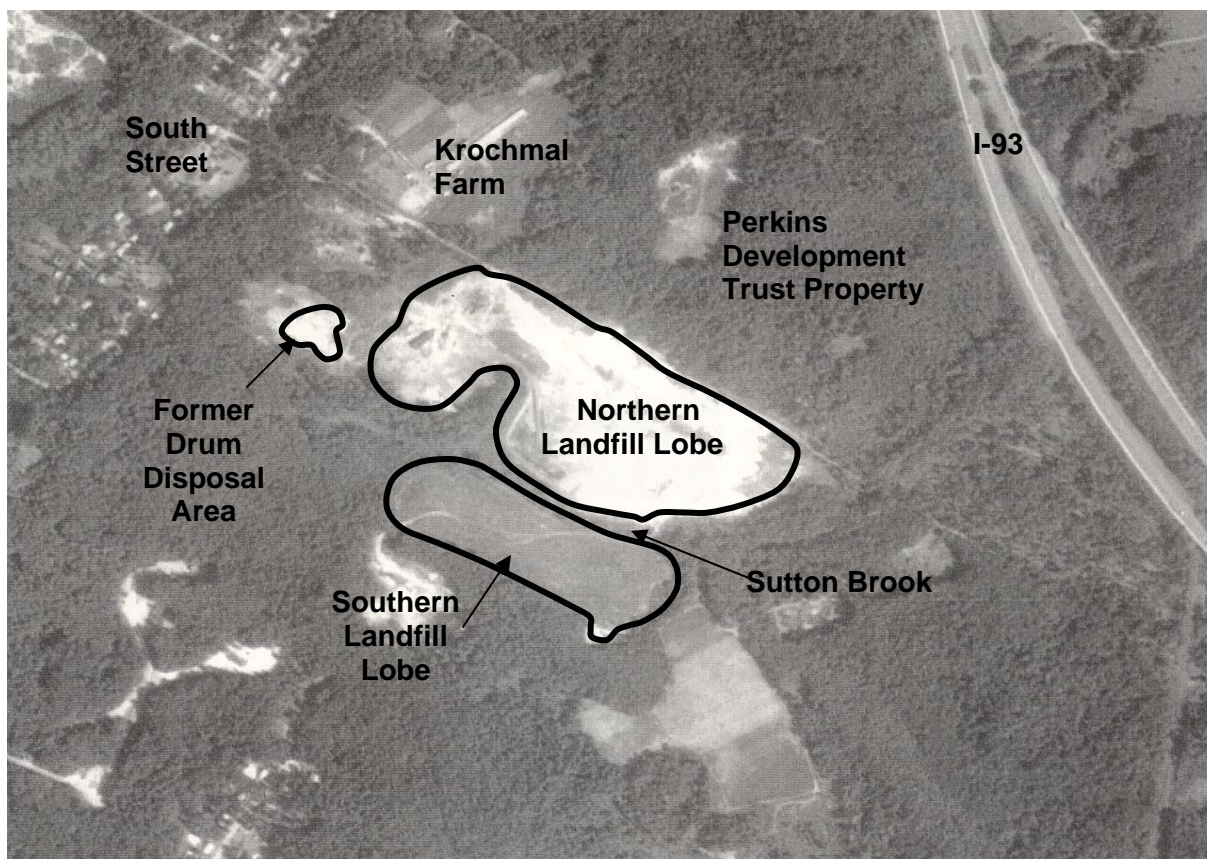
1.2 BACKGROUND

Tewksbury is a semi-rural community located in northeastern Massachusetts, approximately 20 miles north of Boston and occupies approximately 20 square miles of land. For purposes of presentation and discussion, the Site has been divided into two major source areas (Landfill Lobes [Northern and Southern lobes] and Former Drum Disposal Area).

The solid waste source areas on the Site are referred to as the Northern Lobe and Southern Lobe. These Solid Waste Areas comprise about 40 acres of the Site. In 2000, between 300 to 400 buried drums were removed from an area located northwest of the Northern Lobe (referred to as the Former Drum Disposal Area).

Sutton Brook (and associated wetlands) flows east to west through the property, dividing the landfill into Northern and Southern lobes. Additional wetland areas are located south of the landfill and along the eastern and western portions of the property. Each of these areas is shown in a 1980 aerial photograph presented below as Figure 1-4.

Figure 1-4 Aerial View of Landfill (1980)



Potentially sensitive areas and/or human or ecological receptors located in the vicinity of the Site are depicted on Figure 1-5 and include: mapped medium and high yield potentially productive aquifers, freshwater wetlands, areas of protected open space, and approved Zone 2 water supply areas. In addition, several private residential wells are located in the neighborhoods in the vicinity and the Town of Tewksbury has five inactive public water supply wells located southwest of the Site. According to the Town of Tewksbury, all of their former wells on Poplar Street were abandoned in place around the mid



1990's. The access doors to the wells were welded shut and power was removed by the electric company making them totally inoperable. All wells have been de-registered with MassDEP and therefore reuse of these wells is extremely unlikely and would require a lengthy process. Tewksbury is relying on the Merrimack River as its (main and) only source of drinking water.

Figure 1-6 illustrates the site features and ground surface contours, including the locations of the inactive former Town wells and those private wells (most inactive) proximate to the site. Private wells located in an expanded vicinity of the area are shown and discussed on Figure 5-6b.

A summary timeline of milestones associated within the operational, regulatory, and investigation/remediation history of the Site is presented in Table 1-1.

Table 1-1 Timeline of Sutton Brook Disposal Area Milestones

1950s	1957	Waste disposal activities initiate		1950s
1960s	1960's/1970's	Numerous violations of State/Local regulations (landfill burning, uncovered wastes, filling wetlands, waste disposed below water table, etc.)		1960s
1970s		DEP samples on-site well	1976	1970s
		Tewksbury water supply wells and Sutton Brook sampled	1979	
	1979	Landfill's site assignment is rescinded (LF closed)		
		Tewksbury water supply wells and Sutton Brook sampled	1982	
1980s	1988	MADEP observes underground burning in Southern Lobe		1980s
	1988	Landfill operations continue until 1988		
		MADEP conducts air monitoring	1988	
		Initial Site Investigation activities conducted	1989	
1990s		Tewksbury BOH conducts private well sampling	1991	1990s
		Supplemental investigation activities conducted	1991/1992	
		DEP conducts soil gas/groundwater sampling in neighborhood	1992	
		DEP conducts ambient air monitoring in neighborhood and landfill	1992	
		DEP conducts supplemental investigation (groundwater and surface water)	1995	
		DEP/EPA conducts geophysical surveys, soil, groundwater, surface water, and sediment sampling	1999	
2000s		EPA conducts drum and soil removal actions	2000/2001	2000s
		Additional investigation activities conducted (wells, groundwater samples)	2001	
	2001	Site added to NPL list		
		USGS conducts passive vapor diffusion survey in Sutton Brook	2001	
		Contaminated soil stockpile removed from site	2001/2002	
		EPA conducts private residential well sampling	2002	
		Public Health Assessment report issued	2003	
	2004	AOC signed by PRP Group to conduct RI/FS		
		PRP Group initiates RI/FS	2004	
		PRP Group submits Draft Phase 1A RI Deliverable to EPA	2005	
		PRP Group initiates Phase 1B RI field activities	2005	
		PRP Group submits Draft Screening Level Risk Assessment	2006	
		PRP Group submits Draft RI Report to EPA	2006	
		PRP Group submits Draft FS	2006/2007	



1.3 REPORT ORGANIZATION

This report is organized into this introduction and the following sections:

Section 2 - Remedial Investigation – A description and presentation of the data collected at the Site and surrounding areas to be used in the Remedial Investigation including both previous site investigations and the Phase 1A and Phase 1B Remedial Investigations is presented in this section.

Section 3 - Remedial Investigation Laboratory Analytical Data - This section provides a discussion of the usability of the data (both historic and newly collected) and presents the analytical data sets used during the RI and risk assessments.

Section 4 - Environmental Setting - The environmental setting of the Site is presented in the following sections: Geologic Setting; Hydrologic Setting; Hydrogeologic Setting; and Climatological Conditions.

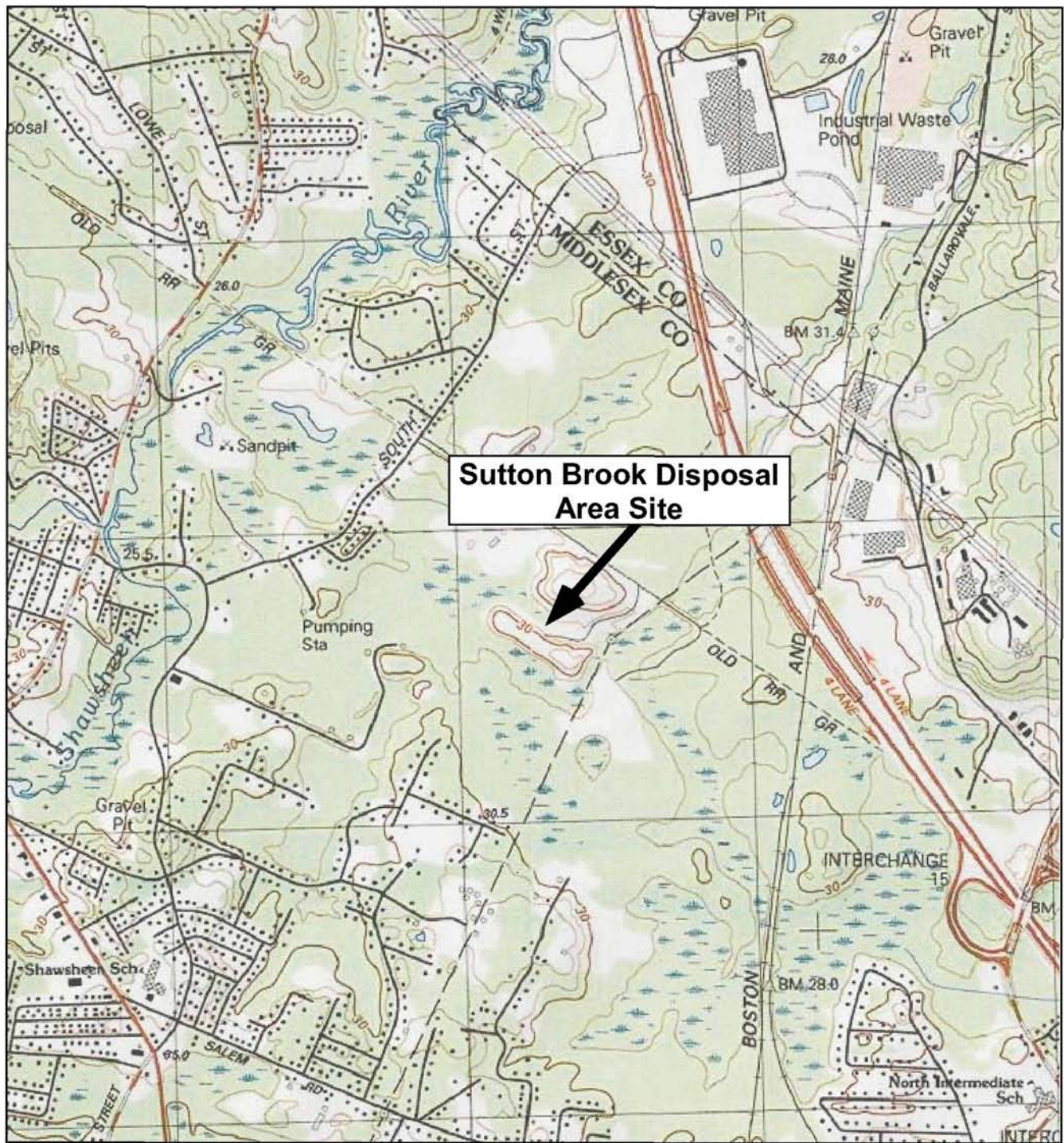
Section 5 – Nature and Extent - The presentation and discussion of the nature and extent of contaminants has been divided into the following groupings: Landfill Lobes; Former Drum Disposal Area and Adjacent Disturbed Area; Former Residence, Garage, and Storage Area; Sutton Brook and Associated Tributaries and Wetland Areas; and Reference Locations.

Section 6 – Contaminant Fate and Transport - This section provides information on the fate and transport processes relevant to potential human and ecological exposures and specific fate and transport information relevant to the contaminants identified at the Site.

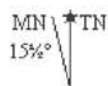
Section 7 – Summary of Findings – An overall summary of the findings of the RI and risk assessment is presented in the section.

Section 8 – References – A listing of applicable references is provided.

The report sections (Sections 1 through 8) complete with text, tables, and figures are provided as Volume I. The report appendices (Appendices A through I) are provided as Volume II.



Base Map Source:
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DES.BY:	DR.BY: EVR	CK.BY:
FIGURE 1-1		
SITE LOCUS MAP		
SUTTON BROOK DISPOSAL AREA		
SCALE: AS SHOWN	JOB NO.: 210517	
DATE: FEBRUARY 2007	FILE NAME: Site Locus 1-1.cnv	

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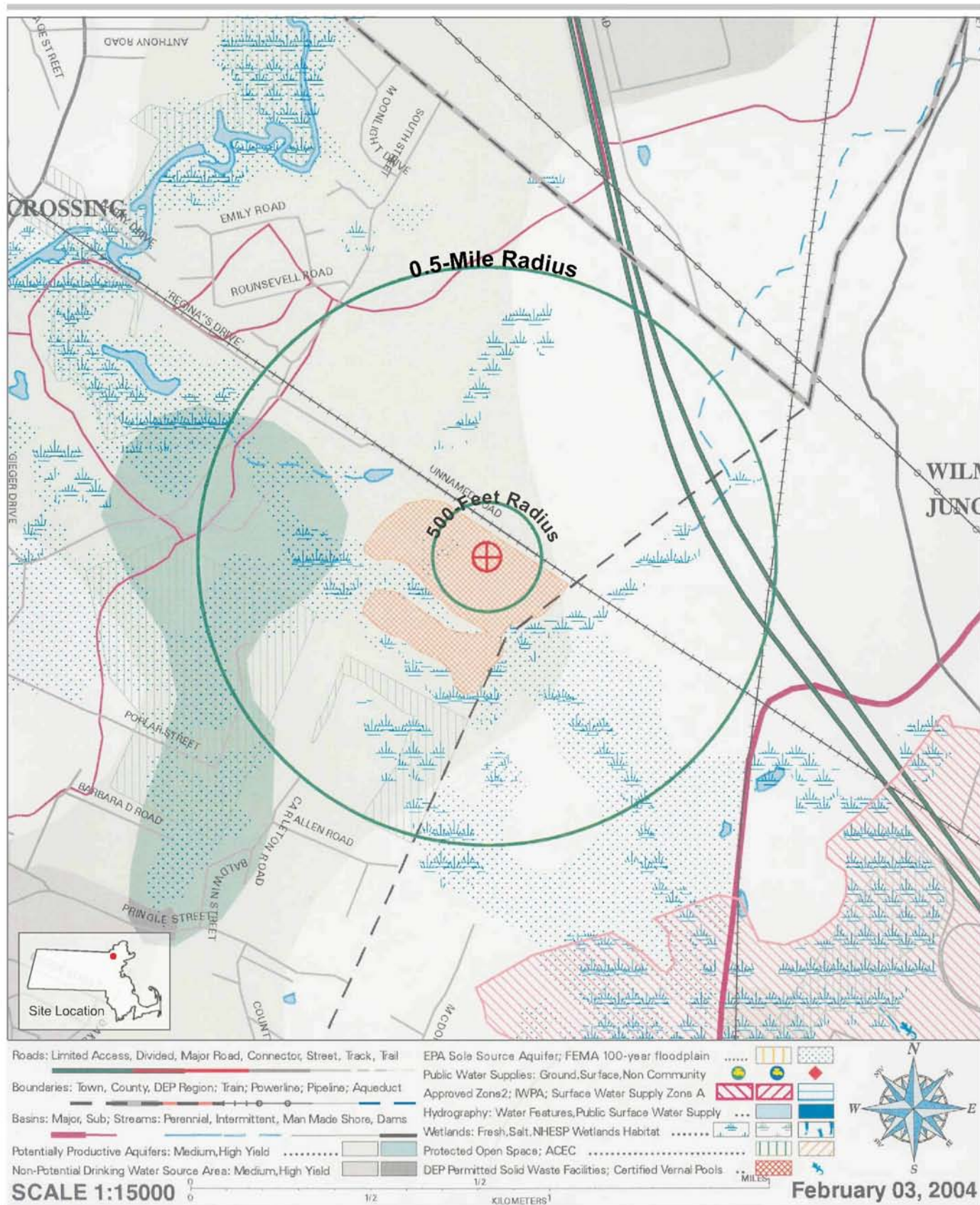
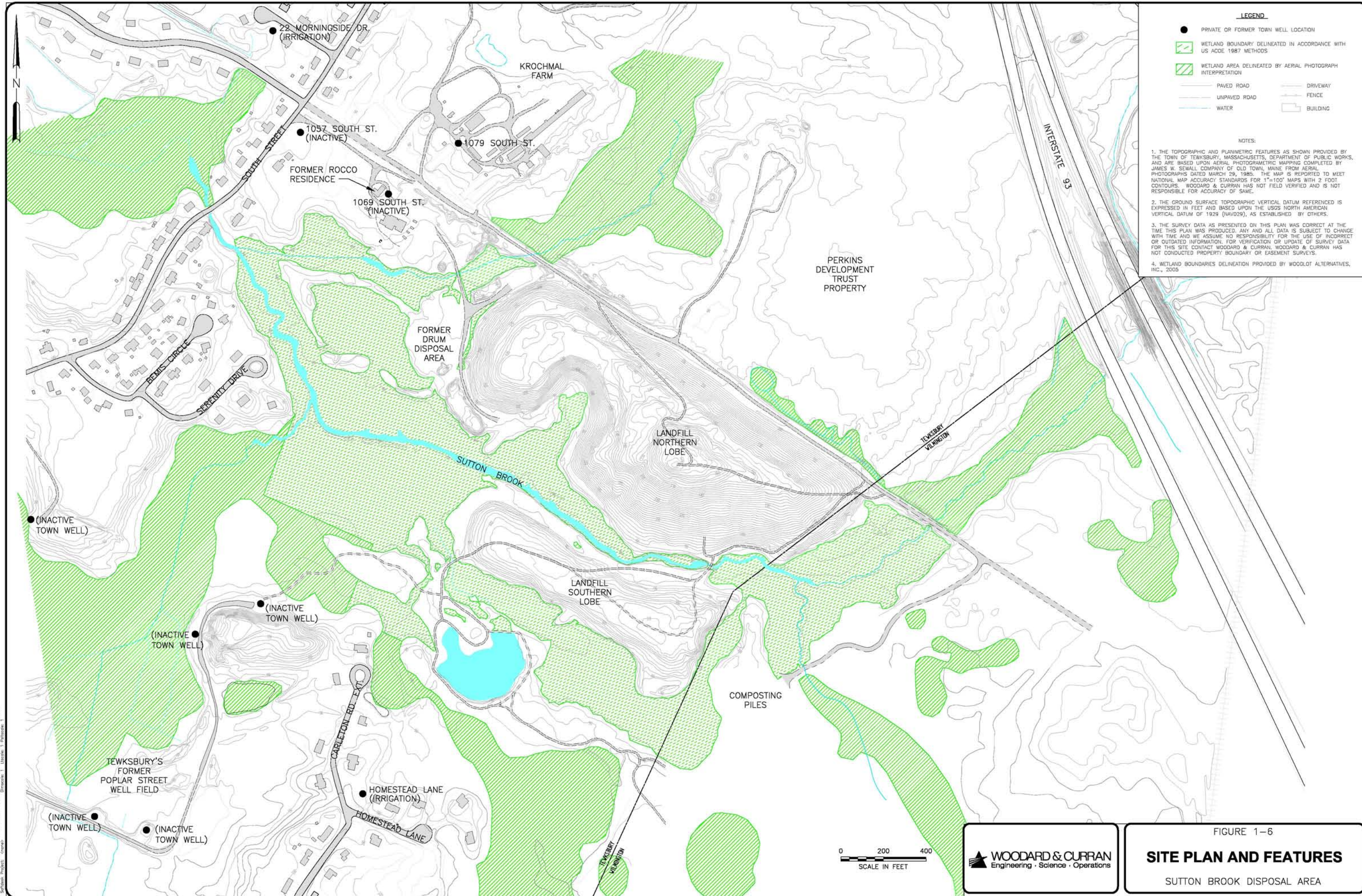


Figure 1-5
Sutton Brook Disposal Area
Surrounding Environs



LEGEND

- PRIVATE OR FORMER TOWN WELL LOCATION
- WETLAND BOUNDARY DELINEATED IN ACCORDANCE WITH US ACCE 1987 METHODS
- WETLAND AREA DELINEATED BY AERIAL PHOTOGRAPH INTERPRETATION
- PAVED ROAD
- UNPAVED ROAD
- WATER
- DRIVEWAY
- FENCE
- BUILDING

NOTES:

1. THE TOPOGRAPHIC AND PLANIMETRIC FEATURES AS SHOWN PROVIDED BY THE TOWN OF TEWKSBURY, MASSACHUSETTS, DEPARTMENT OF PUBLIC WORKS, AND ARE BASED UPON AERIAL PHOTOGRAMETRIC MAPPING COMPLETED BY JAMES W. SEWALL COMPANY OF OLD TOWN, MAINE FROM AERIAL PHOTOGRAPHS DATED MARCH 29, 1985. THE MAP IS REPORTED TO MEET NATIONAL MAP ACCURACY STANDARDS FOR 1"=100' MAPS WITH 2 FOOT CONTOURS. WOODARD & CURRAN HAS NOT FIELD VERIFIED AND IS NOT RESPONSIBLE FOR ACCURACY OF SAME.

2. THE GROUND SURFACE TOPOGRAPHIC VERTICAL DATUM REFERENCED IS EXPRESSED IN FEET AND BASED UPON THE USGS NORTH AMERICAN VERTICAL DATUM OF 1929 (NAVD29), AS ESTABLISHED BY OTHERS.

3. THE SURVEY DATA AS PRESENTED ON THIS PLAN WAS CORRECT AT THE TIME THIS PLAN WAS PRODUCED. ANY AND ALL DATA IS SUBJECT TO CHANGE WITH TIME AND WE ASSUME NO RESPONSIBILITY FOR THE USE OF INCORRECT OR OUTDATED INFORMATION. FOR VERIFICATION OR UPDATE OF SURVEY DATA FOR THIS SITE CONTACT WOODARD & CURRAN. WOODARD & CURRAN HAS NOT CONDUCTED PROPERTY BOUNDARY OR EASEMENT SURVEYS.

4. WETLAND BOUNDARIES DELINEATION PROVIDED BY WOODLOT ALTERNATIVES, INC., 2005

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FIGURE 1-6
SITE PLAN AND FEATURES
SUTTON BROOK DISPOSAL AREA



2. REMEDIAL INVESTIGATION

The overall goal of the investigation is to collect an appropriate and sufficient amount of data to complete the RI, FS, and baseline risk assessments, and identify the preferred remedy. The data collected at the Site and surrounding areas and to be used in the Remedial Investigation is comprised of both previous site investigations and the recently completed Phase 1A and Phase 1B Remedial Investigations (together referred to as the RI). A summary of these investigations is provided in the following sections.

2.1 PREVIOUS INVESTIGATIONS

As indicated in the previous section, there have been numerous investigations and a significant amount of sampling data has been collected across and adjacent to the Site over the years. To aid in determining the “usability” of this data in the RI, the following information was reviewed:

- sample collection methods to ensure appropriate sample collection methods were used;
- laboratory analytical methods to ensure samples were analyzed following standard analytical methods and would be comparable to data collected in the RI;
- data documentation (e.g., laboratory data sheets, boring logs, etc.); and
- data validation records to ensure data is usable for its intended purpose.

The following summarizes the specific reports, data collection events, and data that have been determined to be “usable” for this RI.

Table 2-1 Previous Investigation Data

Report	Description of Data
November 1989, NUS Corporation, Trip Report/On-site Reconnaissance, Soil/Sediment and Leachate Sampling;	October 1989 – 11 soil samples and 3 sediment samples
September 1992, EPA, Ambient Air Survey Results	August 1992 – 7 ambient air samples
June 1996, MADEP, Rocco Landfill Initial Site Assessment (M&E)	Jun - Oct 1995 – 3 landfill gas samples; groundwater samples from 10 monitoring wells; 3 sediment samples; and 3 surface water samples
February 2000, MADEP, Preliminary Data Report, Rocco Landfill Investigation (IT Corporation)	Jun – Jul 1999 - groundwater samples from 26 monitoring wells; and 4 surface water samples
March 2000, EPA, Final Summary Trip Report (Weston)	Aug – Sep 1999 – groundwater samples from 20 monitoring wells; 6 wetland soil samples; 26 upland soil samples; 23 sediment samples; and 9 surface water samples
February 2001, EPA, Removal Program Preliminary Assessment/Site Investigation report 19 Bemis Circle (Weston)	Sep – Oct 2000 – 12 soil samples



Table 2-1 Previous Investigation Data

September 2001, EPA, Data Evaluation Technical Memorandum Final (M&E)	Mar 2001 – groundwater samples from 22 monitoring wells
March 2002, EPA, Removal Program After Action Report (Weston)	Jul – Nov 2000 – 14 post-excavation soil samples
2002, USGS, Distribution of VOCs in Sediments near Sutton Brook Disposal Area	May 2001 – 143 passive vapor diffusion samplers in brook; 7 surface water samples
August 2002 Downgradient Property Status Opinion, Perkins Development Trust (Higgins Environmental)	Apr – Jun 2002 – 7 upland soil samples and groundwater samples from 10 monitoring wells

Those data listed in the table above were determined to be generally comparable with the requirements of the project specific QAPP and the intended use of the data in the RI, based on available information. For example, the post-excavation soil samples that were collected following drum removal in 2000 were deemed usable as part of the nature and extent discussion; however, these data were not used in the risk assessment because the activity documentation only provides summary tables of data with no laboratory data sheets. In addition, subsequent sample collection activities have been conducted in this specific area. As another example, the two soil samples collected by MADEP in 1993 from the 19 Bemis Circle property were not included in this RI given that sufficient samples were collected at this property by EPA contractors in 1999 and 2000 to adequately characterize shallow soils in this area. This data set with respect to VOCs (the 2 soil samples that were collected in 1993 by the MADEP were only analyzed for VOCs) includes 14 separate soil samples collected from locations spatially distributed across the property. The samples were collected from multiple depth intervals ranging from surficial samples (upper six inches of soil) to depths of 12 feet below ground surface.

Section 3 of this report discusses data usability and presents the specific laboratory analytical data by media (both previous investigations and newly collected RI data) that will be used in the RI.

2.2 REMEDIAL INVESTIGATION

The recent RI field activities (e.g., 2004-2006) consisted of activities related to the following tasks:

- Site Survey (elevation and location surveys of investigation points)
- Soils and Sources of Contaminants Investigation (soil borings, surficial soil sampling, and test pit excavations)
- Air Quality Assessment (landfill gas sampling)
- Subsurface and Hydrogeological Investigation (installing temporary and permanent monitoring wells; groundwater sampling; stream piezometer installation; water level measurements; stream gauging; in situ hydraulic conductivity testing; and groundwater modeling)
- Surface Water and Sediment Investigation (surface water, wetland soil/sediment, and sediment sampling)
- Ecological Assessment (wetland delineation; floodplain delineation; and habitat characterization)



The following sections summarize the activities and methods conducted as part of these tasks. More detailed descriptions on the sampling methods and procedures are provided in the Sampling and Analyses Plan [see Appendix D of the September 10, 2004 Workplan (QAPP/FSP)]. All data and results are presented and discussed in the subsequent sections of this report.

Subcontracted services were performed by: New Hampshire Boring of Derry, New Hampshire (drilling and well construction activities); Alpha Analytical Laboratories of Westborough, Massachusetts (laboratory analyses); Aquatic Biological Services of Williston, Vermont (toxicity testing); Data Check of New Durham, New Hampshire (data validation); Richard Kaminski and Associates of Lawrence, Massachusetts (site surveying); and Woodlot Alternatives of Topsham, Maine (habitat, wetland, and floodplain delineation).

To provide “usable” and representative data, consistent field methods and procedures were implemented throughout the RI field investigation program. To provide the required consistency of data collection methods, SOPs were established at the initiation of the investigation. Throughout the field investigation program, a core group of personnel were present on-site who were with the program from its inception, clearly understood the SOPs, and worked closely with all field investigation personnel to insure that the proper procedures were followed. Each of these SOPs is provided in the QAPP.

As described in the project QAPP, a Field Sampling Technical Systems Audit (TSA) of the field activities was conducted at the Site by non-project team W&C personnel (performed during Phase 1A activities on November 3, 2004). Site activities being conducted on the day of the audit included: soil sampling; drilling and monitoring well installation; and groundwater sampling. The results of the audit indicated that site personnel were knowledgeable about the existence of the SOPs/QAPP procedures and demonstrated proper use of the SOPs/QAPP procedures in their sampling and recordkeeping activities.

Site access and entry to all properties required to perform the RI activities was obtained via: 1) signed access agreements (Jon Cave property, Perkins Development Trust property, Raposa property, and Decarolis property); 2) verbal permission from the Town of Tewksbury; or 3) through EPA for the Rocco property (designation as authorized representative of the EPA).

A summary of the completed RI sampling program is provided in Table 2-2. Variations from the proposed activities in the EPA-approved September 10, 2004 RI/FS Workplan and the September 16, 2005 Phase 1B RI Workplan are described in the following section.

2.2.1 Variances from Workplan

The sample and data collection activities, including sample locations, were completed consistent with the EPA-approved Workplans with the exceptions noted below. Throughout the field program, the field activities (plans, schedule, modifications, etc.) were communicated to EPA and MassDEP representatives via weekly e-mails, periodic verbal communications, and the monthly project status conference call. Table 2-2 and associated figures of locations included in this report include these exceptions and represent the actual investigations completed.

- Five test pit excavations were added to further delineate the waste limits in specific areas around the landfill lobes and three additional test pit excavations were completed within adjacent soil/debris piles.
- Soil Sampling program
 - Due to site conditions, many of the originally proposed surface soil locations (referred to as upland locations) were actually located within wetland areas and



therefore have been grouped in the wetland soils group. In addition, a wetland surface soil sample was not collected or analyzed during installation of GP-20, due to the relocation of that well to an upland location (see below). However, a wetland soil sample was collected during installation of GP-8. The net result was collection of the same amount of soil samples as proposed.

- Due to a laboratory miscommunication, one of the five soil samples collected from the landfill cover material for physical characteristic testing was not analyzed.
- Due to subsurface conditions (e.g., running sands) the Geoprobe drill rig was switched out after the first week of the drilling program and a traditional drill rig was used for the remainder of the program. For consistency purposes with the Workplan, the temporary wells retained the “GP” nomenclature identification.
- Drilling Program (all changes approved by EPA/MassDEP):
 - Converted temporary well GP-22 to a permanent well, renamed MW-21M;
 - Moved temporary well GP-20 to a new location;
 - Moved proposed well couplet MW-22M and MW-22B to originally proposed GP-20 location;
 - An additional shallow piezometer, WP-5, was installed (prior to installation of MW-22M/22B) in the wetland area at the location of the proposed MW-22 couplet for water level measurements;
 - Also during drilling activities in October and November 2004, temporary well GP-17 could not be installed due to safety issues resulting from high water. After the difficulties experienced during mobilization to MW-22M/22B, and considering the limited window of opportunity to install wells under frozen conditions (in Winter 2004), GP-17 was not installed during Phase 1A RI activities. Instead, a shallow piezometer (WP-10) was installed in the same location (in the aquatic wetland south of Sutton Brook) on December 1, 2005, during Phase 1B activities.
- Sediment Sampling Program
 - At certain locations on-site, sediment samples contained low percent solids (less than 30% solid content). Specifically, deep marsh sediments sampled from the area south of the Southern Lobe were consistently below 30% solid content. Sediment from this area (and other areas where sediment was suspected to contain low solids content) was sampled consistent with procedures in the Project QAPP, however, in November 2006 samples were decanted and sieved in the field prior to sample submittal to the laboratory, and triple sample volume was collected from each location to provide the laboratory with additional volume for the analyses. The extra volume facilitated the analyses of the samples with lower percent solids for all parameters except VOCs (due to compositing/consolidation conditions of the method).

In addition, minor edits/modifications were made to Tables 7-2 through 7-9, 10-1, and 13-8a of the QAPP. These were submitted to EPA and MassDEP as a QAPP modification on December 16, 2004.

With regard to the sampling and analyses plan, Table 2-3 presents a comparison of those primary and QA/QC samples proposed versus collected during the RI (not including Pre-ROD monitoring events). As indicated on Table 2-3, all proposed samples were collected with the exception or addition of the following:



- Due to the sampling schedule and laboratory shipments (and to meet the requirements of the QAPP), in total, 37 additional trip blanks were submitted for VOC or 1,4-dioxane analysis.
- Given that well GP-17 was not installed during the field sampling activities, the total number of groundwater sampling locations for temporary wells was decreased by one;
- Six of the 46 existing groundwater wells, including two wells that were collected as field duplicates, were analyzed for dissolved (filtered) metals in addition to the originally proposed unfiltered metals;
- Two of the existing wells proposed to be sampled for 2004 MNA parameters (methane, ferrous iron, dissolved organic carbon, sulfite, and sulfide) were not sampled and submitted for those analyses. Instead, two new monitoring wells (MW-22M and MW-23B) were sampled and submitted for MNA analysis. Additional MNA sampling was performed in 2006, in coordination with the June 2006 Pre-ROD monitoring and sampling. The data in Table 2-3 includes both 2004 and 2006 MNA sample locations;
- During the surface soil sampling program, one of the field duplicates and one MS/MSD sample was not collected. Other sampling locations were collected according to plan;
- Due to a laboratory miscommunication, one of the five soil samples collected from the landfill cover material for physical characteristic testing was not analyzed and samples collected from the Deep Marsh that were identified for total organic carbon testing were not analyzed due to holding time exceedances; and
- Due to the instantaneous nature of the leachate sampling and the lack of sufficient quantities, a field duplicate was not collected when the leachate samples (LF-1 and LF-2) were collected.

2.2.2 Site Survey

Field surveys were conducted during four separate mobilizations to determine the locations and elevations of environmental investigation sampling points, as well as to refine the site features base map. The field surveys included:

- September to December 2004 – Newly installed test pits (TPs), monitoring wells (MW-21/MW-21M and MW-23B), temporary monitoring wells (GPs), microwells (DEPs), soil borings (SBs), surficial soil samples (SS or WS), well points and stream piezometers (WPs/SW99s), monitoring wells located on the Perkins property (PMWs, OWs, WES-01/WED-02/WEB-03), the Town of Tewksbury wells (Ts), the soil gas points (SGs) and survey monuments at the Northern and Southern Lobes (SGs), and surface water and sediment samples (SW or SD);
- February and April 2005 – Newly installed monitoring wells (MW-22M/MW-22B), monitoring wells located on the Krochmal Farm property (KFMW-11, KFMW-12, and KFMW-15) and leachate samples (LF);
- December 2005 – New sampling points, including the new monitoring wells and stream piezometers installed during the Phase 1B Remedial Investigation (MW-24/MW-24M, MW-25/MW-25M, and WP-6 through WP-13), surficial soil samples (SS or WS), and surface water and sediment samples (SW or SD); and
- November and December 2006 – New sampling points, including the surface water and sediment samples collected in Sutton Brook, Southern Tributary, and Deep Marsh; and the landfill gas probes (SG's).

A description of all surveys is provided below.



2.2.2.1 Horizontal Location Surveys and Mapping

The horizontal location of each sampling point, monitoring well, and wetland flag was determined using a Trimble Pro XL[®] Global Positioning System (GPS) receiver and field data collector, or equivalent. The sampling point locations, as plotted on the site base maps, are within the acceptable mapping accuracies and represent the sampling locations referenced to the USGS North American Datum of 1927 (NAD27), Massachusetts State Plane Coordinate System.

2.2.2.2 Elevation Surveys

Elevations were measured by differential leveling techniques utilizing an automatic level and a 25-foot telescopic, fiberglass leveling rod. Elevations were established at all newly installed monitoring wells and temporary wells at the ground surface, top of PVC casing, and top of steel protective casing, if present. Elevations were also established at the stream piezometers and at survey monuments on the Northern and Southern Lobes of the landfill. This survey was tied into the existing survey completed at the Site in 2001. All elevations are referenced to the North American Datum of 1988.

The vertical survey data generated by the field surveys was reduced and the differential level loops were numerically closed, balanced and adjusted. Survey documentation (for all surveys) is provided in Appendix A.

2.2.3 Soils and Sources of Contaminants Investigation

Consistent with the RI/FS Workplan, the following field activities were conducted as part of this task:

- Site Reconnaissance;
- Test Pit Excavations;
- Soil Borings;
- Surficial Soil Samples; and
- Leachate Samples.

A description of these activities is described in the following paragraphs.

2.2.3.1 Site Reconnaissance

From the time that field operations commenced in September 2004, site reconnaissance activities were performed to visually inspect the landfill lobes and site features on multiple visits to the Site. During such site visits, field personnel noted, if present, vegetative stresses, the presence of wastes, seeps, surface run-off patterns, etc. Field personnel also identified existing sampling stations and wells; marked proposed sampling locations in the field; and determined accessibility, staging, and decontamination areas.

These features were used to finalize the locations of specific sampling points and to update/revise the site feature/base map.

2.2.3.2 Test Pit Excavations

From September 27 to October 1, 2004, thirty-eight test pit excavations were conducted around the landfill lobes. The purpose of the test pits was to determine the extent of the landfilled waste. The



program augmented the existing data from previous investigations, including historical data concerning filling practices at the Site, previous test pit excavations, and aerial photographs of the Site.

Twenty-one test pit excavations were completed around the perimeter of the Northern Lobe and fourteen test pits were completed around the perimeter of the Southern Lobe using a track-mounted excavator. In addition to those locations around the landfill lobes, three test pits were excavated to investigate suspect debris/soil piles located adjacent to the landfill lobes.

During test pit excavations, soils were screened for VOCs using a hand-held photoionization detector (PID) meter and the soils/waste subsurface profile was logged. The size of the test pit and the depth to groundwater was also noted. A summary of the information collected during this activity is presented in the Test Pit Logs, included as Appendix B.

The test pit orientation and extent were determined in the field based on the subsurface materials encountered. All test pit excavations were advanced until the limits of solid waste were determined. Upon this determination, the waste limit was staked and surveyed using the GPS instrumentation. The surveyed test pit locations are shown on Figure 2-1. NOTE: This figure also includes the test pit locations previously completed at the Site.

In general, the dimensions of the test pits were 3-4 feet wide by 15-30 feet long and extended to a depth of 15 feet (maximum) below grade. Groundwater was encountered at nine of the test pit locations. Solid wastes encountered in the test pits ranged from typical household wastes to burnt or ash layers to areas of debris comprised of wood, metal, concrete, etc. The results of the test pits have been incorporated into the nature and extent discussion of the landfill lobes (refer to Section 5.1).

2.2.3.3 Soil Borings

From October 4 to October 11, 2004, ten soil borings were advanced at the Site following the procedures described in the project QAPP. The soil borings were advanced within the former drum disposal area and the former Rocco residence, garage, and storage area. The purpose of the soil borings was to obtain subsurface soil samples and assess soil quality (unsaturated and saturated) within these areas of the Site.

The locations of the soil borings are shown on Figure 2-2. It should be noted that the drawings depicting the sample collection locations show all previous and newly collected data locations if they have been determined usable and included in this RI (see Section 2.1 above).

A discussion of the soil borings within these two areas is provided in the following paragraphs.

2.2.3.3.1 Former Drum Disposal Area

Six soil borings (SB-1 through SB-6) were advanced within the former drum disposal area. Three of the soil borings in this area (SB-1, -4, and -6) were advanced using a Geoprobe track-mounted rig, while the other three soil borings (SB-2, 3, and 5) were advanced with an ATV-type CME 550 drill rig. The depth of the soil borings varied from 15 to 37 feet below grade and was based on visual staining, elevated PID readings, or rig limitations.

The soils collected from each boring were visually logged for soil classification. Soils collected from the soil borings were screened with a hand-held photoionization detector (PID) meter and a selected subset of samples were also field screened using a field gas chromatograph (GC) equipped with a PID and electron



capture detector (ECD). The field GC was used for the following reasons: 1) confirm total VOC analyzer data and provide indication of specific VOCs detected in the samples (i.e., develop relative VOC response factors within a borehole; aid in well screen selection, etc.); 2) used in conjunction with the total VOC analyzer to select specific samples for laboratory analyses; and 3) aided in identifying specific VOCs in samples when the FID analyzer was used (e.g., GC did not detect methane whereas the FID detected methane concentrations, which at some locations was elevated).

The identification of specific compounds with the field GC is based on a comparison of sample response factors to those of known standards. Given the data quality objectives for the use of the field GC (indicted above), intensive calibration techniques were not employed; rather the general signature of the compound peaks and relative size of the response factors (in volt-seconds) were used in the data evaluation.

The soil jar headspace results as well as the soil classification data are presented on the individual soil boring logs provided in Appendix C. The field GC chromatograms for the soil borings are also included in Appendix C. NOTE: Copies of logs for soil borings and monitoring wells (newly installed and existing) are provided in Appendix C.

Soil samples from the soil borings in this area were collected and analyzed for VOCs, SVOCs, PCBs/pesticides, and TAL metals. Sample depths varied from surface (0-2 feet below ground surface) to 10-12 feet below ground surface and were based on previously existing data collected in this area, visual staining, and/or field screening results. Additional discussion on the results of these borings is presented in Section 5.2.

2.2.3.3.2 Former Rocco Residence, Garage, and Storage Area

Four soil borings (SB-7 through SB-10) were advanced near the former Rocco residence, garage, and storage area using a Geoprobe track-mounted rig. The depth of the soil borings varied from 12-feet to 25-feet and was based on visual observations (i.e., staining) or field screening results (i.e., elevated PID readings).

Similar to the soils collected from the former drum disposal area, the soils collected from each boring were logged for soil classification and field screened with a hand-held photoionization detector (PID) meter. A subset of the samples were also screened using a field gas chromatograph (GC) equipped with a PID and electron capture detector (ECD). The soil jar headspace results as well as the soil classification data are presented on the individual soil boring logs provided in Appendix C. The field GC chromatograms for the soil borings are also included in Appendix C.

Soil samples were collected and analyzed for VOCs, SVOCs, PCBs/pesticides, and TAL metals. Sample depths varied from surface (0.5-1 foot below ground surface) to 7.5 feet below ground surface and were based on previously existing data collected in this area, visual staining, and/or field screening results.

Additional discussion on the results of these borings is presented in Section 5.3.

2.2.3.4 Surficial Soil Samples

In addition to the test pit excavations and soil borings, surficial soil samples were collected from areas spatially distributed across the Site to assist in the characterization of soils and sources of contaminants.



Soil samples were collected using hand augers, soil probes, and split spoon samplers from both wetland and upland areas and from the Northern and Southern Lobes of the landfill.

On November 8-9 and November 23, 2004, surface soil samples (SS and GP) and wetland soil (WS) samples were collected from twenty locations. Eleven additional surface soil samples and wetland soil samples were collected on December 1-2, 2005. The samples were collected from ground surface to 1 or 2 feet below grade following the procedures described in the project QAPP. The locations of the surface soil samples are shown on Figure 2-2. It should be noted that the drawings depicting the sample collection locations show all previous and newly collected data locations if they have been determined usable and included in this RI (see Section 2.1 above).

Each sample (including the twenty collected in November 2004 and the eleven collected in December 2005) was submitted for laboratory analysis of VOCs, SVOCs, PCBs/pesticides, TAL Metals, TOC, and pH, with select samples also analyzed for dioxins (SS-1, SS-5, SS-8, and SS-9).

To further aid in the physical characterization of the existing landfill cover soils, five surface soil samples were collected from the landfill lobes following the procedures described in the project QAPP. Three samples, SG-1, 2, and 3 were collected from the Northern Lobe and two samples, SG-4 and SG-5 were collected from the Southern Lobe (see Figure 2-2). The soil samples were analyzed for physical characteristic testing (including moisture density, soil strength, and grain size). However, due to a laboratory miscommunication, one of the three soil samples collected from the Northern Lobe (SG-3) was not analyzed for physical characteristic testing.

Survey monuments were also installed on top of the landfill lobes at these locations (SG-1 through SG-5) for periodic elevation measurements (settlement assessment). The monuments were included in the Site Survey activities (see Section 2.2.2 above).

2.2.3.5 Leachate Samples

On numerous occasions an inspection of the landfill lobes was performed to determine the presence of leachate outbreaks. The potential presence of a leachate outbreak was only observed in April 2005 during a period of high water table conditions.

On April 25, 2005, two leachate samples (LF-1 and LF-2) were collected from leachate outbreaks identified at the landfill. One sample (LF-1) was collected from near MW-3S on the Northern Lobe and another was collected from the area between GP-15 and GP-16 on the Southern Lobe. In both areas, there were no active seepages. However, the orange to rust colored stains on the ground surface represented former liquid areas, and in other areas, ponded water with the same rust to orange color was still present. The water also was characterized by a translucent to rainbow sheen, with some emulsification and effervescence also noted. The samples were collected from this ponded water and submitted for VOCs, SVOCs, PCBs/pesticides, and TAL Metals.

Similar staining evident of leachate was also identified at:

- Northern Lobe – Four smaller areas on the western slope of the landfill between the toe of the slope and the brook; and
- Southern Lobe – One ponded area along the roadway atop the landfill and also the area near GP-11, just past the bridge from the Northern Lobe.

Discussion on the results of the landfill leachate samples is presented in Section 5.1.



2.2.4 Air Quality Assessment

On October 28, 2004, field personnel conducted landfill gas sampling within the landfill lobes to help obtain a current understanding of landfill gas concentrations/composition.

Five landfill gas samples (three on the Northern Lobe, SG-1 through SG-3; and two on the Southern Lobe, SG-4 and SG-5) were collected in accordance with the procedures described in the QAPP and analyzed for percent methane, percent carbon dioxide, percent oxygen, and hydrogen sulfide using a four-gas meter calibrated for each specific gas. One sample from each of the five locations was also collected and submitted to the off-site laboratory for volatile organics analyses (Method TO-15). The samples were collected from 2 feet below ground surface using vapor probes, and represent 4-hour composite samples. The sampling locations (SG-1 through SG-5) are shown on Figure 2-2.

Three additional temporary soil gas probes were installed along the northern property (and landfill waste) boundary on December 11, 2006. The three points (SG-6, SG-7, and SG-8) were installed to a depth of 7 feet, 5 feet, and 5 feet below ground surface (bgs), respectively. Each point was constructed with ¾" PVC slotted screen extending from the bottom of the well to a depth of approximately 2 feet bgs, followed by PVC riser extending to approximately 3 feet above the ground surface. A protective casing (1½" black steel pipe) was installed over the PVC to prevent damage to the probes. Following installation, the newly installed soil gas probes (SG-6, SG-7, and SG-8) and existing monitoring wells PMW-1, PMW-2, PMW-3, and/or PMW-6 were monitored for methane (%volume and %LEL), hydrogen sulfide, oxygen, and/or carbon dioxide.

The results of the landfill gas sampling are discussed in Section 5.1.

2.2.5 Subsurface and Hydrogeological Investigation

Based on the review of the existing site data and conceptual site model, and consistent with the RI/FS Workplans, the following field activities were conducted as part of this task:

- Existing Monitoring Well Viability Assessment;
- Temporary Well Installation, Development and Sampling;
- Monitoring Well Installation and Development;
- Groundwater Quality Sample Collection and Analyses; and
- Aquifer Characteristic Testing and Evaluation.

A description of these activities is described in the following paragraphs.

2.2.5.1 Existing Monitoring Well Viability Assessment

On October 11, October 27, and November 22-23, 2004, field personnel conducted a series of well viability tasks to assess whether the existing wells were in usable condition and if they could be sampled and gauged for water level measurements as part of this RI.

This task consisted of a visual assessment of the exterior integrity of the well (well cap, lock, cement cap, etc.) as well as monitoring the well headspace using a hand-held photoionization detector (PID) or flame ionization detector (FID) meter. The well headspace was also monitored for methane, carbon dioxide, oxygen, and hydrogen sulfide concentrations using a four-gas meter calibrated to measure the specific gases. The depth to water and depth of each well was measured and compared to existing well



construction documentation. An oil/water interface probe was used on wells that had previously shown evidence of viscous substances. No separate phase product (floating) was measured in any of the wells.

A summary of the information collected during the well viability tasks is presented on Table 2-4. The results of this task indicated that all forty-six wells proposed for sampling were accessed and determined viable for groundwater sampling. The six microwells installed by the MADEP in 1999 were either not located or deemed not viable for future sampling. Additional wells located on the Perkins Development Trust property, the Krochmal Farms property, and the Town of Tewksbury's Poplar Street wellfield were also accessed and deemed viable for water level measurements. Field personnel were unable to open the existing locks found on the majority of the wells and subsequently cut and replaced all locks.

The locations of the monitoring wells are shown on Figure 2-3.

2.2.5.2 Temporary Well Installation, Development and Sampling

The installation of the temporary groundwater wells commenced with the installation of GP-2 on October 12, 2004 and ended on November 16, 2004 with the installation of GP-20. During this period of time, twenty-five temporary wells were drilled and installed following the procedures described in the project QAPP, or modifications thereof, described in Section 2.2.1.

The purpose for installation of these temporary wells was to assess the distribution of contaminants in the groundwater directly adjacent to and downgradient of the landfill lobes and former drum disposal area and to fill data gaps identified during review of existing groundwater information.

In addition, five well points (WP-6 through WP-10) were also installed on December 1-2, 2005, for the purpose of groundwater sampling during Phase 1B RI field activities. These well points were installed in areas determined to be inaccessible by drill rig. Each of the well points consists of 2 feet of screen and were installed at depths varying from 1.5 to 10 feet bgs. Eight other well points/stream piezometers, WP-1 through WP-5, and WP-11 through WP-13 were also installed to aid in determining water levels and to assess groundwater/surface water interactions.

The locations of the temporary wells, including the well points/piezometers, are shown on Figure 2-3 (GP-1 through GP-26; excluding GP-17, not installed, and GP-22 which was later converted to permanent monitoring well MW-21M; and WP-1 through WP-13).

As a result of accessibility issues (i.e., wetland areas, etc.) and project constraints, different drilling rigs were used to install the temporary wells. All borings were advanced to the specified boring depths and soil samples were collected at continuous intervals. The soil samples were screened using a hand-held photoionization detector (PID) or flame ionization detector (FID) meter and also with a field gas chromatograph (GC) equipped with a PID. The field GC was used during the investigation for the following reasons: 1) confirm total VOC analyzer data and provide indication of specific VOCs detected in the samples (i.e., develop relative VOC response factors within a borehole; aid in well screen selection, etc.); 2) used in conjunction with the total VOC analyzer to select specific samples for laboratory analyses; and 3) aided in identifying specific VOCs in samples when the FID analyzer was used (e.g., GC did not detect methane whereas the FID detected methane concentrations, which at some locations was elevated). All field GC chromatograms for these soil borings are included in Appendix C.

The boring logs, well construction diagrams, and the well point installation reports for each location are included in Appendix C. Each well log provides the date of installation, the type of rig used for installation (as applicable), the depth of the wells and screened intervals, and other pertinent information about each specific location.



The temporary wells located in between the two landfill lobes were generally screened across the water table surface because the primary purpose was related to hydraulics and leachate evaluations. The temporary wells located away from the landfill lobes and used to evaluate potential downgradient impacts from the southern lobe and former drum disposal area were screened at intervals based on field screening (PID/GC) results. If field screening indicated that VOCs were detected in soil samples, then the borings were advanced until refusal (e.g., equipment or geologic limitations) or until two successive samples exhibited a decrease in VOC concentrations. Upon completion of the boring, a well screen interval was selected, which corresponded to the highest readings recorded on the soil jar headspace measurements. After each temporary well was installed, the wells were developed by purging several volumes of water from the well by inertia lift principles, using tubing and a check valve. New polyethylene tubing was used for each well, and the stainless steel check valve was decontaminated between each use.

Following development, groundwater samples were collected via modified low-flow sampling methods consistent with the project QAPP. Sampling occurred on October 14 and 21 and on November 2, 3, 4, 11, and 23, 2004. The parameters monitored during sampling included: pumping rate; purged volume; dissolved oxygen (DO); temperature; specific conductivity (SEC); pH; oxidation-reduction potential (ORP); and turbidity. Drawdown was measured in most wells, although when the probe and tubing could not fit down the well, field personnel were unable to constantly monitor the water level. The Groundwater Sampling Records for the temporary well sample events are included as Appendix D.

Upon stabilization, as defined in the QAPP, samples were collected and submitted for VOCs (including 1,4-dioxane) and select inorganics analysis (arsenic, cadmium, lead, iron, manganese, magnesium, and hardness). A total of 24 temporary wells were sampled. In some cases, due to the specific geologic formation or construction details of the temporary wells (e.g., no filter packs), the turbidity stabilized above 30 NTUs when all other parameters were also stable. As specified in the QAPP, if stabilization of all criteria was not achieved within sixty minutes, samples were collected. With regard to turbidity, 64% of the temporary wells stabilized with turbidity values less than 30 NTUs.

A summary of the field chemistry data for the temporary wells, showing the stabilized values for each of the above criteria is provided on Table 2-5. The results from the sampling activities are discussed in Section 5.

2.2.5.3 Monitoring Well Installation

Based on the results of the historical data review, existing well viability, test pitting, temporary well installation and sampling, and Phase 1A RI results (as applicable), nine new permanent monitoring wells were installed: MW-21/21M, MW-22M/22B, MW-23B, MW-24/24M, and MW-25/25M. The locations and screened intervals for these wells were discussed and agreed to by EPA and MassDEP prior to installation. The purpose of the permanent monitoring wells was to fill in data gaps in the existing monitoring well network and obtain groundwater samples to further characterize groundwater conditions. Figure 2-3 shows the locations of these additional wells as well as all existing monitoring wells.

The well couplet MW-21 and MW-21M was initially installed as a single Geoprobe (temporary well) location (GP-22) on October 29 and November 1, 2004. In anticipation, the standard procedure for construction of a permanent monitoring well was followed during installation of GP-22. On November 17, 2004, field personnel returned to GP-22 to oversee the placement of a protective casing (converting GP-22 to MW-21M) and the installation of water table well MW-21. This well couplet, as well as the MW-22M/22B couplet (see below), was installed downgradient of the Southern Lobe.

After attempting access to the location of well couplet MW-22M and MW-22B on several occasions in October and November 2004, it was concluded that the wells could not be installed at that time due to



safety issues resulting from high water in the area. Under frozen conditions, MW-22M and MW-22B were installed from January 31 to February 8, 2005. Monitoring well MW-22M is an intermediate well screened from 26-36 feet below ground surface (bgs), with the screened interval based on field screening results (maximum readings). Monitoring well MW-22B is a bedrock well screened from 56-66 feet bgs, with the screened interval based on the fracture frequency encountered in the upper 20 feet of rock (46-66 feet bgs).

On November 18-19, 2004, MW-23B was installed north of the Site on the Perkins Development Trust property. MW-23B was selected as a reference well location to aid in determining upgradient bedrock groundwater quality. It is screened from 48 to 58 feet bgs, based on the fracture frequency encountered in the upper 20 feet of rock (48-68 feet bgs).

Well couplets MW-24/24M and MW-25/25M were installed in the residential neighborhood west of the Site and of Sutton Brook as part of the Phase 1B RI field activities conducted in 2005. MW-24 and MW-24M were installed on November 15-16, 2005, adjacent to 50 Serenity Drive. MW-25 and MW-25M were installed on November 18 and 22, 2005, adjacent to 14 Bemis Circle.

MW-24/24M and MW-25/25M were advanced using a truck-mounted drill rig with hollow stem augers. Both monitoring well MW-24M and MW-25M are intermediate wells with the screened interval based on field screening results (maximum readings). MW-24M is screened at a depth of 19.5-29.5 feet bgs and MW-25M is screened at a depth of 23-33 feet bgs. Both MW-24 and MW-25 are water table wells, screened at 3-13 feet bgs and 10-20 feet bgs, respectively.

It should be noted that during the drilling of MW-25, the Town's water supply line was encountered and ruptured. Although all proper pre-drilling and mark-out activities were followed (Dig Safe and Road Opening Permits) and the utilities were marked out in the field, the line was encountered outside of the markings. Initial sampling results show evidence of influence from this condition (trihalomethanes were detected in groundwater samples). This condition is discussed further in Section 5.6.

As part of the borehole advancement on each of the new monitoring wells, continuous split spoon soil samples were collected, classified, and field screened with a hand-held photoionization detector (PID) meter. A subset of the soil samples were also field screened on the portable field GC. The field GC was used for the following reasons: 1) confirm total VOC analyzer data and provide indication of specific VOCs detected in the samples (i.e., develop relative VOC response factors within a borehole; aid in well screen selection, etc.); 2) used in conjunction with the total VOC analyzer to select specific samples for laboratory analyses; and 3) aided in identifying specific VOCs in samples when the FID analyzer was used (e.g., GC did not detect methane whereas the FID detected methane concentrations, which at some locations was elevated). The data was also used specifically at the upgradient bedrock well location to assess overburden conditions and the need for an additional deeper overburden well.

The boring logs and well construction diagrams for each location are included in Appendix C. Each well log provides the date of installation, the type of rig used for installation, the depth of the wells and screened intervals, and other pertinent information about each specific location. All field GC chromatograms used for information during these tasks are also included in Appendix C.

2.2.5.4 Groundwater Sample Collection and Analyses

Following the installation and development of new wells MW-21, MW-21M and MW-23B, groundwater samples were collected from each viable existing well and MW-21/21M and MW-23B, and submitted for laboratory analyses. Sampling of the existing monitoring wells on-site occurred during the week of



November 15-19, 2004. Sampling of the newly installed monitoring wells (which at that point included: MW-21/21M and MW-23B) occurred on December 8, 2004.

Sampling of the monitoring wells on the Perkins Development Trust property occurred on November 22-23 and December 8, 2004. Two of the monitoring wells on the Perkins Property, WEB-03 and PMW-2, were resampled on January 5, 2005 due to uncertainties associated with the initial, draft unvalidated data. Upon review of this data, the specific VOCs detected in the two wells and their concentrations were exactly the same in both samples. The laboratory sample log and chain of custody procedures did not indicate any deviations or exceptions from the standard operating procedures and the other parameters analyzed by the laboratory from these wells were not the same. Given these results, both wells were resampled and reanalyzed for VOCs only. The January 5, 2005 sample is consistent with historic data from these wells and is used in this RI.

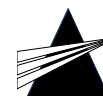
Following the installation (January 31 – February 8, 2005) and development (February 25, 2005) of MW-22M and MW-22B, groundwater samples were collected on March 17, 2005 from the wells.

Following installation and development of newly installed monitoring wells MW-24/24M and MW-25/25M (completed November 15-22, and November 30, 2005 during Phase 1B RI field activities), groundwater samples were collected and submitted for analysis on December 13-14, 2005. Groundwater sampling was performed at these wells again on February 9, 2006, to provide an additional round of results to use in the RI.

As described in Section 2.3, quarterly pre-Record of Decision (ROD) groundwater monitoring was initiated at the Site in September 2005 following submittal of the pre-ROD Monitoring and Sampling Plan. Groundwater from 18 wells was collected over one year of quarterly monitoring, including: September 19-20, 2005; December 14-19, 2005; February 14-16, 2006; and June 5-8, 2006. Based on the results of these four quarterly rounds of monitoring, the frequency of the monitoring program was modified from quarterly to semi-annually (Spring and Fall), except that competent bedrock wells and upgradient monitoring well PMW-6, which have been non-detect for VOCs, were modified to annual sampling. One Pre-ROD monitoring event has been completed since this modification, in October (Fall) 2006. All Pre-ROD data from September 2005 up to and including October 2006 is included in this RI.

The purpose of all groundwater sampling events was to obtain a current understanding of contaminant distribution in groundwater. Groundwater samples were collected via modified low-flow sampling methods following EPA Guidance and the procedures described in the project QAPP. Dedicated tubing was used at each location. The parameters monitored during sampling included: drawdown, pumping rate; purged volume; dissolved oxygen (DO); temperature; specific conductivity (SEC); pH; oxidation-reduction potential (ORP); and turbidity. The Groundwater Sampling Records for each monitoring well sample event are included in Appendix D.

Upon stabilization, samples were collected and submitted for VOCs (including 1,4-dioxane), SVOCs, and TAL metals. A total of 61 wells were sampled (36 wells identified as MW-1 through MW-19; 9 new wells identified as MW-21/21M, MW-22M/22B, MW-23B, MW-24/24M, and MW-25/25M; 7 wells identified as WES-01 through WED-07; 4 wells identified as PMW-1, PMW-2, PMW-3, and PMW-6; and 5 well points identified as WP-6 through WP-10). In November 2004, fifteen wells were also analyzed for monitored natural attenuation (MNA) parameters, including ferrous iron, sulfite, sulfide, methane, and dissolved organic carbon. In June 2006, twenty-six wells were sampled for MNA parameters, including ferrous iron, nitrate, sulfate, methane, and total alkalinity. Note that wells were sampled at least twice for analysis, and some were sampled more than twice.



In some cases, due to the specific geologic formations, turbidity readings stabilized above 30 NTUs when all other parameters were also stable. With regard to turbidity, 88% of the wells stabilized with turbidity values less than 30 NTUs. To aid in assessing potential interferences in the results for those wells that didn't stabilize below 30 NTUs, specifically with regard to metals, 14 groundwater samples were collected from wells with turbidity values that stabilized above 30 NTUs (from a range of screened interval depths) and were submitted for dissolved (filtered) metals analysis (in addition to total, unfiltered metals).

A summary of the results for the 14 samples analyzed for both unfiltered (total) and dissolved (filtered) metals is presented in Table 2-6. As indicated on this table, the average concentrations of unfiltered and filtered metals for these wells were generally in good correlation, with the unfiltered results slightly higher than the filtered results; therefore, it does not appear that turbidity readings above 30 NTUs are affecting the metals results. The two metals with the greatest variance were aluminum and arsenic. Based on a review of the data set, at this time, all unfiltered inorganic data has been used in the site characterization and consequently used in the risk assessment.

Table 2-6 Comparison of Unfiltered to Filtered Metal Results

Metal	Unfiltered (Total)			Filtered (Dissolved)		
	MIN	MAX	AVERAGE	AVERAGE	MAX	MIN
Aluminum	0.089	5.9	1.601	0.038	0.051	0.02
Arsenic	0.019	1.76	0.494	0.242	1.08	0.005
Barium	0.004	0.82	0.324	0.228	0.72	0.007
Beryllium	0.0004	0.008	0.002	0.002	0.008	0.004
Cadmium	0.0004	0.011	0.002	0.002	0.009	0.0005
Calcium	12	420	137	125	390	11
Chromium	0.003	0.03	0.009	0.004	0.005	0.001
Cobalt	0.001	0.01	0.006	0.006	0.01	0.003
Copper	0.003	0.02	0.006	0.005	0.006	0.003
Iron	4.4	700	162	122	650	0.042
Lead	0.0048	0.0048	0.005	ND	ND	ND
Magnesium	3	100	49	44	100	2.7
Manganese	0.05	11	2.451	2.131	10	0.007
Nickel	0.0033	0.094	0.035	0.031	0.08	0.0047
Potassium	1.6	160	80	70	150	1.7
Sodium	9	410	188	171	400	8
Vanadium	0.001	0.02	0.010	0.008	0.03	0.001
Zinc	0.005	0.033	0.020	0.020	0.027	0.006
All concentrations are in milligrams per liter (mg/l); ND = Not Detected "AVERAGE" concentrations include non-detect samples calculated as half the reporting limit.						

A summary of the field chemistry data for all wells and all sample dates, indicating the stabilized values for all criteria, is presented on Table 2-7. Plots of the values collected during the Phase 1A RI, Phase 1B RI, and all pre-ROD sampling events for the parameters pH, specific conductance, oxidation-reduction potential, and dissolved oxygen are presented on Figure 2-4.

Review of the dissolved oxygen and oxidation-reduction potential measurements indicate a reducing environment with low dissolved oxygen and oxidation-reduction potential readings across most of the Site. Dissolved oxygen concentrations ranged from 0.03 mg/L to 9.97 mg/L. However, generally, the



dissolved oxygen concentrations were less than 1.0 mg/L (72% of the readings). The ORP results collected from 78% of the sampling locations at or around the Northern and Southern Lobes of the landfill measured below zero (negative), indicating a reducing environment.

As shown on Figure 2-4, the pH readings across the Site were fairly consistent and within the range of 5.0 to 8.0 standard units with few exceptions. The pH readings measured in groundwater from the bedrock monitoring wells were consistently higher than those measured in water table or intermediate monitoring wells. Specifically, the pH results from eight bedrock monitoring wells (WEB-3, MW-7R, MW-8R, MW-13B, MW-16B, MW-17B, MW-18B, and MW-19B) measured greater than 9. The consistently high pH detected in groundwater at these wells most likely is attributed to grout contamination during well installation given that the open borehole wells and bedrock wells not pressure grouted exhibited lower pH readings. In addition, pH levels appear to be decreasing with time in the wells with higher pH readings.

The specific conductivity readings were generally low and consistent, however, higher readings were observed in those wells proximate to the landfill lobes (see Figure 2-4).

2.2.5.5 Aquifer Characteristic Testing

Consistent with the RI/FS Workplan, the following field activities were conducted as part of this task:

- Water level measurements;
- Stream piezometer installation;
- Stream gauging;
- In-situ hydraulic conductivity tests; and
- Three-dimensional groundwater flow model.

2.2.5.5.1 Water Level Measurements

Water level measurements from all accessible wells and piezometers were collected on: December 16, 2004; April 20, September 19, and December 12, 2005; February 21, May 25, and October 2, 2006. A total of 117 data points (wells and piezometers) were measured to help determine gradients and flow paths at and surrounding the Site. A summary of the water level measurements, discussion of groundwater levels and gradients, and approximate groundwater flow directions is presented in Section 4.

2.2.5.5.2 Stream Piezometer Installation

Initially, four well points were installed on-site to assess groundwater/surface water interactions within Sutton Brook. WP-3 and WP-4 were installed on October 11, 2004 and WP-1 and WP-2 were installed on October 27, 2004.

In addition to the four originally proposed stream piezometers: WP-5, was installed on December 6, 2004 in the wetland area at the location of the MW-22 couplet (before well installation) for water level measurements; and WP-6 through WP-13 were installed at select locations around the Site on November 30 - December 2, 2005 during Phase 1B RI field activities. These piezometers were installed to aid in determining water levels and to collect shallow groundwater samples for analysis.

All piezometers consisted of slotted points, with galvanized steel riser and cap, and were installed at depths ranging from 2 to 10 feet below ground surface (or stream bed surface). The piezometer locations (WP-1 through WP-13) are shown on Figure 2-3.



2.2.5.5.3 Stream Gauging

Stream gauging was performed at eight locations along Sutton Brook (A, B, D, E, F, G, H, and I) on November 19, 2004, September 22, 2005, and January 10, March 1, June 5, and October 2, 2006. Measurements of flow were taken using a flow-meter attached to a Vernier scale wading rod, calibrated to use the 6/10 depth method. Flow measurements were taken in accordance with USGS standard methods for stream gauging (USGS, 1982). The stream gauging locations are shown on Figure 2-3.

The data collected on September 22, 2005 represented a low-water event and many gauging locations along tributaries to Sutton Brook were dry and therefore not measured. At other locations the flow was too low for accurate measurements. The results of all gauging events are discussed further in Section 4.

2.2.5.5.4 In-Situ Hydraulic Conductivity Tests

Eleven in-situ hydraulic conductivity tests were conducted to provide information in each of the flow zones spatially distributed across the Site:

- 3 water table wells (MW-3S, MW-7S, and MW-17S)
- 4 intermediate overburden wells (MW-4S, MW-7M, MW-9, and MW-17D)
- 4 bedrock wells (MW-3B, MW-4B, MW-7R, and MW-17B)

The tests were conducted on December 17, 2004 (MW-3S, MW-3B, MW-4S, MW-4B) and on December 29, 2004 (all remaining wells). At each well, field personnel: measured and recorded the water level; conducted in-situ hydraulic conductivity tests following the rising or falling head test method; and reduced and interpreted data.

A summary of the hydraulic conductivity results and interpretation of the data is presented in Section 4. The time drawdown graphs and data sheets are presented in Appendix E.

2.2.5.5.5 Three-Dimensional Groundwater Flow Model

A groundwater model for the Site was constructed based on the Site's conceptual model. The data used to construct the model has been incorporated from a number of sources including well logs, boring logs and field mapping. Additional data provided from nearby pumping tests aided in the calibration of the model.

Boundary conditions of the model were assigned based on observed surface water bodies, observed topographical divides and known bedrock outcroppings. Sutton Brook and associated tributaries and wetland areas were simulated using the MODFLOW river package. Groundwater divides were simulated using no-flow boundaries.

Given the site geology, a two layer model was constructed based on the presence of two distinct stratigraphic layers, a relatively conductive stratified glacial drift of up to 50 feet thick, and an underlying, marginally conductive till layer from one to 10 feet thick. Model layers were created using Kriging for spatial interpolation of known formation thicknesses and the results were imported into the model. Aquifer parameters were assigned within the ranges of known field data and within acceptable ranges for material types (where aquifer tests were not available).

Sensitivity analyses of model parameters indicated a high sensitivity to both horizontal and vertical hydraulic conductivity values. These analyses allowed the physical properties of the model to be optimized, based on the minimization of sum of squared means. Additional parameters used to conduct these analyses include annual recharge and river conductance.



The groundwater model for the Site provides a good correlation relative to groundwater flow when compared to plots of potentiometric surfaces at the Site. In particular, the flow of groundwater away from each of the two landfill lobes toward the brook is preserved. In addition, groundwater discharge to Sutton Brook predicted by the model is similar to values calculated from stream gauging at sites along the brook. The groundwater model was benchmarked against a second set of data independent from the calibration set and modeled groundwater discharging to Sutton Brook matched well with the measured values from the stream gauging.

A discussion of the model results is provided in Section 4 and a report describing the model development and calibration is provided as Appendix F.

2.2.6 Surface Water and Sediment Sampling

Twenty-eight surface water and thirty-six sediment samples (SW/SD-30 through SW/SD-43 (2004); SW-101 through SW-111 (2005); SD-200 through SD-221 (2006); and SW-214, SW-215, and SW-222 (2006)) were collected from Sutton Brook, the associated tributaries, and the shallow man-made pond to aid in identifying the nature and distribution of impacted surface waters and sediments.

On October 21-22, 2004, surface water and sediment samples were collected from eleven locations (SW/SD-31 through SW/SD-38, SW/SD-40, SW/SD-41, and SW/SD-43). Surface water and sediment samples were collected on October 28 (SW/SD-39 and SW/SD-42) and on November 23, 2004 (SW/SD-30), after access to the Perkins Property was granted. Samples were also collected on December 1-2, 2005, during the Phase 1B RI field activities, and again on November 9-10, 2006, during field activities conducted at the Deep Marsh and Southern Tributary.

The surface water and sediment sampling locations were sampled by collecting samples directly into the laboratory bottles (surface water) or by using a sampling trowel or hand auger (sediments) in accordance with the procedures described in the project QAPP. At several of the locations, a canoe was needed to access the sampling locations and collect the samples.

With regard to sediment, multiple samples did not meet the percent solids content criteria specified in the project QAPP ($>30\%$); however, the samples were still determined to be representative of the sediments in the respective areas and the data was qualified accordingly. Specifically, 97% of the total data set comprising rejected sediment data resulted from qualification of non-detect results due to the low percentage of solids (less than or equal to 30% and greater than or equal to 10%) in the sediment. In addition, approximately 36% of the positive sediment results were estimated (J qualified) as a result of the same issue with the low percentage of solids. Similar qualifications were made to soil samples collected, though it was not as abundant. The majority of the samples with the low percent solids contained or were comprised of peat/organic material. Data validation and usability of the sediment data is discussed in more detail in Section 3.

The surface water and sediment sample locations are shown on Figure 2-5. The drawings depicting the sample collection locations show all previous and newly collected data locations if they have been determined usable and included in this RI (see Section 2.1 above). For the purpose of this RI, samples are considered “sediment” if they are located beneath standing water, such as the brook or pond, as well as stagnant wetland areas that are underwater all or part of the year (aquatic wetland habitats).

At the time of sample collection, the following parameters (for surface water) were also monitored in the field: dissolved oxygen (DO); temperature; specific conductivity (SEC); pH; and turbidity. A summary of these readings is presented in Section 5.

Surface water and sediment samples were analyzed for VOCs, SVOCs, total metals, and PCBs/pesticides. In addition, surface water samples were analyzed for hardness, nitrates, and sulfate; and sediments for



TOC and grain size. Toxicity testing was also performed on select sediment samples collected from the Southern Tributary. Thirty-one surface water samples, including samples collected during the pre-ROD monitoring program, were also analyzed for dissolved (filtered) metals for use in the risk assessments. To aid in the ecological risk assessment, six of the sediment samples (SD-31 through SD-34, SD-36, and SD-38) were analyzed for AVS/SEM.

The discussion of the surface water and sediment sample results is provided in Section 5.

2.2.7 Ecological Assessment

The objective of this task was to collect field data necessary to support the ecologic risk assessment.

On June 3, 2004, a reconnaissance-level ecological characterization was conducted to identify natural communities occurring on-site and to document vertebrate wildlife species that could reasonably be expected to occur on-site. Areas of relatively uniform plant species composition were delineated on an ortho-corrected aerial photograph and communities were identified largely by the dominant woody species present. This assessment was completed by Woodlot Alternatives under the assistance of a W&C biologist. Woodlot Alternative's Ecological Assessment report, dated July 2004, is provided in Appendix G.

In October 2004, Woodlot Alternatives conducted the following activities: delineated wetlands regulated by the MADEP, US Army Corps of Engineers, and the EPA; completed a wetland functions and values assessment; and delineated the 10- and 100-year floodplain elevation at the Site. Woodlot's report, dated January 2005, is provided in Appendix G.

2.3 PRE-RECORD OF DECISION (ROD) MONITORING AND SAMPLING

To determine potential seasonal variability, as well as potential changes in the nature, distribution, and quantity of contamination, or the environmental fate and transport, reference levels, and migration pathways at the Site, groundwater and surface water quality were monitored regularly from September 2005 to October 2006. All data collected from the pre-ROD events, including the most recent October 2006 event, is presented and used in this RI. This section describes the scope of the pre-ROD monitoring and sampling as it has evolved since September 2005.

Initially (September 2005), each quarterly pre-ROD monitoring event consisted of collecting and analyzing groundwater samples from 18 monitoring wells. During the semi-annual events (September 2005 and February 2006), in addition to the groundwater samples, surface water samples were collected and analyzed from four sampling stations in Sutton Brook. The results of the first four pre-ROD events (September 2005, December 2005, February 2006, and June 2006) indicated that, overall, contaminant concentrations were relatively steady, with some localized changes and slight variability due to seasonal variations (low water versus high water conditions). Based on this information, the frequency of the program was modified from quarterly to semi-annually (Spring and Fall) for the majority of the sample points, with competent bedrock wells and upgradient well PMW-6 sampled annually.

A brief description of the site conditions encountered during each quarterly event follows:

- September 2005 – The September 2005 event was a “low water” event that occurred in the late summer after a period of little rainfall (1.41 inches over the previous month, as measured at the Shawsheen River USGS gauging station near Wilmington, MA, 01100600). The average ambient air temperature at the site was approximately 65°F, and the average groundwater



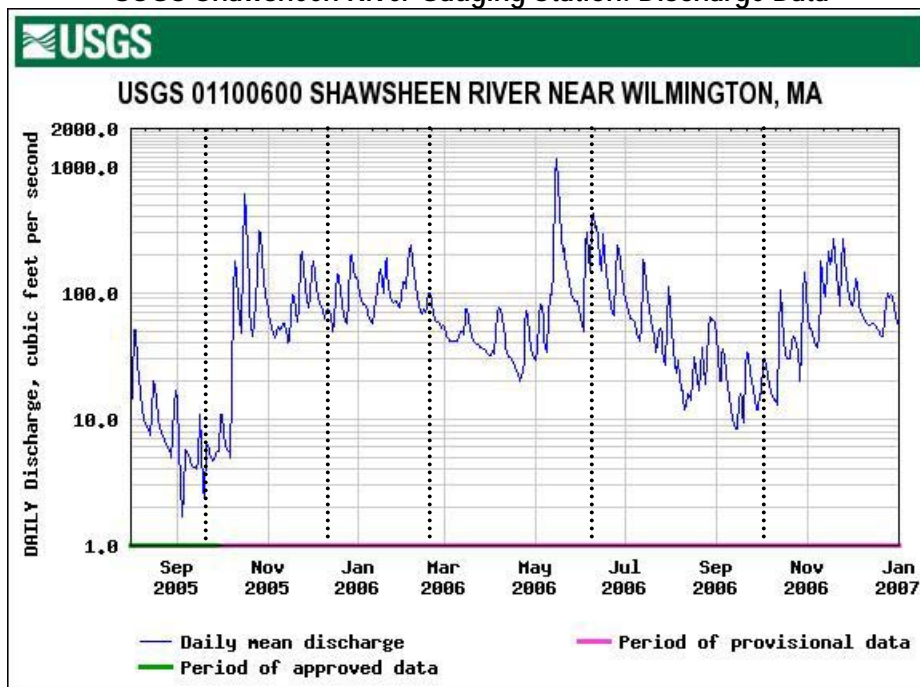
temperature (as measured in the monitoring wells screened across the water table surface) was 59°F.

- December 2005 – The December 2005 event occurred during an early winter freeze/thaw period, following a moderate period of precipitation (4.85 inches over the previous month). As determined by reviewing the discharge measured at the Shawsheen River, the sampling event occurred during a freeze period between two different thaw periods. The average ambient air temperature at the site was approximately 25°F, and the average groundwater temperature was 49°F.
- February 2006 – The February 2006 event occurred during the winter, following a heavy snowfall when the site was covered with 10-12 inches of snow. However, the average ambient air temperature at the site during the event was approximately 35°F, and due to these temperatures, the Shawsheen River was experiencing a surge from the snow melt. The average groundwater temperature was 48°F.
- May/June 2006 – The June 2006 event was a “high water” event that occurred during the spring, following heavy periods of rain. There was one large precipitation event in May 2006, as well as additional precipitation both immediately before and during the sampling. In all, 12.57 inches of precipitation was measured during the month prior to the sampling event (one of the highest recorded months in 70 years). The average ambient air temperature at the site was approximately 60°F, and the average groundwater temperature was 53°F.
- October 2006 – The October 2006 event occurred in the late summer, during low water conditions; though observed water levels were not as low as September 2005. The measured precipitation for the month leading up to the sampling was 2.34 inches, scattered over five different events. The average ambient temperature at the site was approximately 65°F, and the average groundwater temperature (as measured in the monitoring wells screened across the water table surface) was 57°F.

The following graphs show the discharge and precipitation, respectively, as measured at the USGS Shawsheen River Gauging Station near Wilmington, MA (Station 01100600). The dashed lines on the figures represent each sampling event.

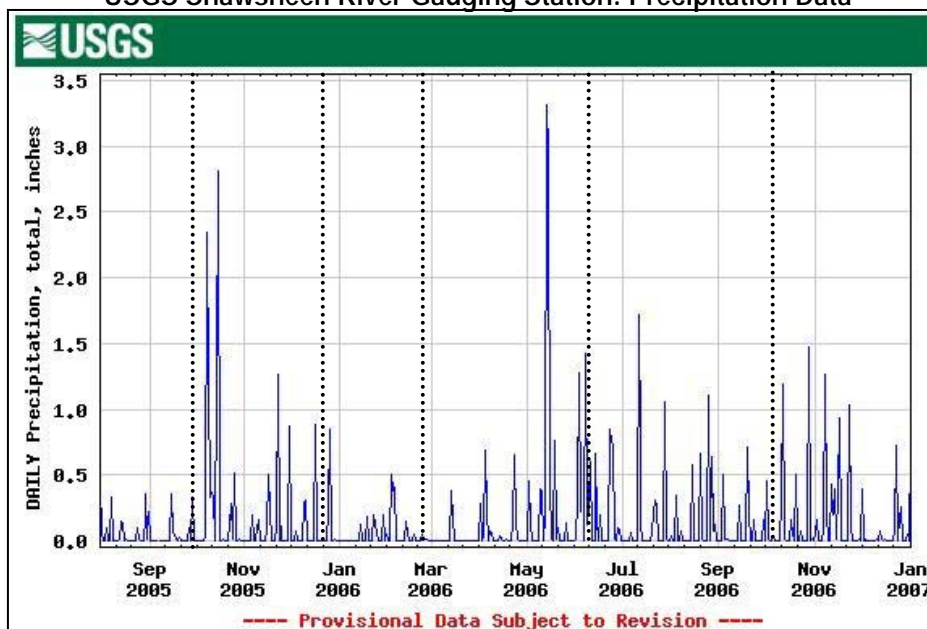


USGS Shawsheen River Gauging Station: Discharge Data



Source: USGS National Water Information System, February 2007

USGS Shawsheen River Gauging Station: Precipitation Data



Source: USGS National Water Information System, February 2007



2.3.1 Groundwater and Surface Water Sampling and Analyses

Based on a review of historic and current data (collected through the Phase 1A RI, March 2005), the following outlines the sample selection rationale that was used in determining the Pre-ROD monitoring locations for the period of September 2005 to October 2006:

- Groundwater samples were collected from monitoring wells (screened at different depth intervals): adjacent to, and downgradient of the landfill lobes; from monitoring wells within and downgradient from the Former Drum Disposal Area; from the downgradient site perimeter; and from wells upgradient of the site. Groundwater samples were analyzed for: volatile organic compounds (VOCs) plus 1,4-dioxane, total (unfiltered) and/or dissolved (filtered) metals, and field chemistry parameters (pH, specific conductance, ORP, dissolved oxygen, and turbidity). In addition, five of the wells (identified as source area wells) were analyzed for SVOCs during each event.
- Surface water samples were collected from stations located along Sutton Brook, at upgradient and downgradient locations, as well as at specific locations between the landfill lobes and downgradient of the Former Drum Disposal Area. Surface water samples were analyzed for: VOCs plus 1,4-dioxane, total (unfiltered) and dissolved (filtered) metals, and field chemistry parameters (pH, specific conductance, ORP, dissolved oxygen, and turbidity).

The locations of the pre-ROD sampling locations have been highlighted on Figure 2-6.

A summary of the pre-ROD monitoring program, incorporating the modifications made to the previous program is provided in Table 2-8.

2.3.2 Groundwater and Surface Water Gauging

During each pre-ROD sampling event, a complete round of water levels is collected from each accessible site monitoring well and stream piezometer. In addition, stream gauging data is also collected at select locations within the brook and associated tributaries to aid in assessing seasonal variations in surface water flow. All water measuring and gauging activities are conducted in accordance with the project QAPP. Data collected is used in determining the groundwater and surface water movements, and seasonal variations, which are presented and discussed in more detail in Section 4.

Table 2-2

Summary of RI Field Investigation
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Area	Task	Investigation Type	Media	IDs	Rationale	No. Locations	Depth (ft bgs)	No. Lab Samples	Laboratory Analyses (See Notes)	Field Analyses/Observations
Landfill Lobes	Soils and Sources of Contaminants	Site Recon	N/A	N/A	Physical inspection of lobes; sampling location mark-out; accessibility determinations, etc.	NA	NA	NA	NA	Visual characterization
		Test Pits	Soil	TP-1 to TP-30	Waste delineation of Landfill Lobes (24 TPs around northern lobe; 14 TPs around southern lobe); Engineering Purposes	38	<10	0	None	Visual characterization; total VOC screening
		Leachate Breakouts, if present	Leachate	LF-1, LF-2	Assess leachate from landfill lobes	2	Surface	2	VOC, SVOC, Metals, PCBs, Pesticides	pH, Conductivity, Temperature
		Soil Probe	Soil	SG-1 to SG-5	Surface soil data for use in FS/remedy design	5	0 - 1.0	4	Grain size, moisture density, soil strength	Visual characterization; total VOC screening
	Air Quality Assessment	Soil Gas Survey	Landfill gas	SG-1 to SG-5	Landfill gas data for use in FS/remedy design	5	<5	5	VOCs	% methane, % oxygen, H ₂ S
				SG-6 to SG-8		3	<10	0	None	% methane, % oxygen, H ₂ S and %carbon dioxide
Former Drum Disposal Area	Soils and Sources of Contaminants	Geoprobe - Soil	Soil	SB-1 to SB-6	Characterization samples from Former Drum Disposal Area	6	15 +	6	VOC, SVOC, Metals, PCBs, Pesticides	GC field screening w/PID, Visual characterization
Former Garage, Residence, and Storage Area	Soils and Sources of Contaminants	Geoprobe - Soil	Soil	SB-7 to SB-10	Characterization samples	4	15 +	4	VOC, SVOC, Metals, PCBs, Pesticides	GC field screening w/PID, Visual characterization
On-Site Surface Soils and Wetland Areas (outside limits of landfill lobes and drum disposal area)	Soils and Sources of Contaminants	Hand Auger -Upland Surface Soil	Soil	SS-8	Use in risk assessment and to delineate extent of contamination	1	0 - 1.0	1	VOC, SVOC, Metals, PCB, Pesticides, TOC, pH, Dioxins	Visual characterization
		Hand Auger - Wetland Surface Soil	Soil	WS-6, WS-15, GP-1, GP-7, GP-8, GP-23, SS-5, SS-9, SS-12, SS-13, SS-14	Use in risk assessment and to delineate extent of contamination	11	0 - 1.0	11	VOC, SVOC, Metals, PCB, Pesticides, TOC, pH	Visual characterization
		Hand Auger - Wetland Surface Soil	Soil	WS-106, WS-107	Use in risk assessment and to delineate extent of contamination	2	0 - 1.0	2	Metals	Visual characterization
		Hand Auger - Wetland Surface Soil	Soil	SS-5, SS-9	Assess for the presence of dioxins in soils associated with former burning operations (areas outside the presumptive landfill cap)	2	0 - 1.0	2	Dioxins	Visual characterization
		Hand Auger - Wetland Sediment	Sed	WS-7, WS-10, WS-11 WS-16, WS-101 to WS-105	Use in risk assessment and to delineate extent of contamination	9	0 - 1.0	9	VOC, SVOC, Metals, PCB, Pesticides, TOC, pH	Visual characterization
				SD-216 to SD-221	Use in risk assessment and to delineate extent of contamination	6	0 - 1.0	6	VOC, SVOC, Mercury, TOC (Grain size for SD-216)	Visual Characterization

Table 2-2

Summary of RI Field Investigation
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Area	Task	Investigation Type	Media	IDs	Rationale	No. Locations	Depth (ft bgs)	No. Lab Samples	Laboratory Analyses (See Notes)	Field Analyses/Observations
Reference	Soils and Sources of Contaminants	Hand Auger -Upland Surface Soil	Soil	SS-1, SS-2, SS-3, SS-108, SS-110	Reference Locations - Areas anticipated to be unaffected by site operations, but that may be affected by other local non-site sources including roadway runoff, atmospheric deposition, etc.	5	0 - 1.0	5	VOC, SVOC, Metals, PCB, Pesticides, TOC, pH (Dioxins for SS-1)	Visual characterization
		Hand Auger - Wetland Surface Soil	Soil	WS-4, WS-109, WS-111, WS-112, WS-113		5	0 - 1.0	5	VOC, SVOC, Metals, PCB, Pesticides, TOC, pH	Visual characterization
	Surface Water Sampling	Surface Water	SW	SW-30 and SW-222		2	NA	5	VOC ¹ , SVOC, Metals, PCB, Pesticides, Hardness, Nitrates, Sulfate for SW-30 (Metals and Hardness only for SW-222)	Temperature, pH, Conductivity, DO, Turbidity, ORP
	Sediment Sampling	Sediment	Sed	SD-30, SD-200 and SD-201		3	0 - 0.5	3	VOC, SVOC, Metals, PCBs, Pesticides, grain size, TOC for SW-30 and Arsenic, Iron, grain size and toxicity testing for SD-200 and SD-201	Visual Characterization
Overall Site Groundwater	Subsurface and Hydrogeological Investigation	Temporary Wells - Groundwater	GW	GP-1 to GP-26 (GP-17 not installed; GP-22 converted to MW-21M)	Evaluate groundwater flow and discharge locations; assess water quality	24	10 - 30 ⁺	26	VOCs ¹ and inorganics (As, Cd, Pb, Fe, Mg, Mn, hardness); GP-24 also for MNA parameters	Temperature, pH, Conductivity, DO, Turbidity, ORP
		New Monitoring Wells	GW	MW-21 to MW-25	Characterize downgradient overburden and bedrock groundwater; upgradient bedrock groundwater; and groundwater hydrology and chemistry in the area further west of Sutton Brook	9	various	31	VOC ¹ , Metals and select wells for SVOC and MNA parameters	Temperature, pH, Conductivity, DO, Turbidity, ORP
		Existing Monitoring Wells	GW	MW-1 to MW-19; WES-01 to WED-07; PMW-1, PMW-2, PMW-3, PMW-4, PMW-6 (Perkins property)	Monitor groundwater quality; evaluate monitored natural attenuation of dissolved chemicals	47	various	138	VOC ¹ , SVOC, Metals and MNA parameters	Temperature, pH, Conductivity, DO, Turbidity, ORP
		Stream Piezometers in Brook/Wetlands	GW	WP-1 to WP-5 WP-11 to WP-13	Aid in evaluating groundwater to surface water discharge and to determine groundwater flow direction and rate	8	0-5.0	0	NA	NA
		Stream Piezometers in Brook/Wetlands	GW	WP-6 to WP-10	Aid in evaluating contaminants in shallow groundwater and groundwater to surface water discharge	5	0-10.0	5	VOC ¹ , SVOC, Metals (also WP-6 and WP-7: PCB, Pesticides)	Temperature, pH, Conductivity, DO, Turbidity, ORP
		Water levels	GW	all wells	Aid in determining groundwater flow direction and rate	all	various	NA	NA	NA
		In-situ hydraulic conductivity testing	GW	MW-7S/M/R; MW-9, MW-17S/D/B, MW-3S/B; MW-4S/B	Aid in determining groundwater velocity	11 locations (3 water table; 4 intermediate; and 4 bedrock)	various	NA	NA	NA

Table 2-2

Summary of RI Field Investigation

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Area	Task	Investigation Type	Media	IDs	Rationale	No. Locations	Depth (ft bgs)	No. Lab Samples	Laboratory Analyses (See Notes)	Field Analyses/Observations
Sutton Brook and Site Surface Waters	Surface Water and Sediment Sampling	Surface Water	SW	SW-31 to SW-43 SW-101 to SW-111 SW-214 and SW-215	Locations along Sutton Brook and associated tributaries and wetlands, including contaminant groundwater discharge areas from Southern Lobe and the Former Drum Disposal Area; use in human health and ecological risk assessments	26	NA	35	VOC ¹ , Metals, Hardness, Nitrates, Sulfate (subset of locations for SVOC, PCB, Pesticides)	Temperature, pH, Conductivity, DO, Turbidity, ORP
		Sediment	Sed	SD-31 to SD-43 SD-202 to SD-215	Locations along Sutton Brook and wetlands; use in human health and ecological risk assessments	27	0 - 1.0	27	VOC, SVOC, Metals, PCBs, Pesticides, grain size, TOC, AVS/SEM, and Toxicity Testing	Visual characterization
Overall Site	Ecological Assessment	Habitat assessment; wetlands and flood plain delineation	Various	NA	Identify ecological communities, habitat types, and species present on or surrounding the site	NA	NA	NA	NA	Visual characterization
	Site Survey	Survey	N/A	all locations	Survey sampling locations; install settlement survey monuments on landfill lobes	All	NA	NA	NA	NA

Notes:

For specific laboratory analyses of individual samples, refer to Section 3.

DO = dissolved oxygen

DOC = dissolved organic carbon

ft bgs = feet below ground surface

GW = groundwater

NA = Not applicable

ORP = oxygen reduction potential

PID = photoionization detector

Sed = sediment

AVS = acid volatile sulfide

SW = surface water

SVOC = semivolatile organic compound

VOC = volatile organic compound

VOC¹ = volatile organic compounds plus 1,4-dioxane

TOC = total organic carbon

SEM = simultaneously extracted metals

Table 2-3

QA/QC Summary Table
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Medium/Matrix	Analytical Parameter	Concentration Level	Analytical Method	Data Evaluation - Tier Level	No. of Sampling Locations	No. of Field Duplicate Pairs	Organic		Inorganic		Expected No. of VOA Trip Blanks ⁽²⁾	No. of Equip. Blanks	Total No. of Samples
							No. of MS	No. of MSD	No. of Duplicates	No. of Spikes			
Surface Water													
Surface Water	VOC with TICs	Low	8260B	III	25/25	2/2	2/2	2/2			2/3		33/34
	1,4-dioxane	Low	5030C/8260B	III	25/25	2/2	2/2	2/2			3/3		34/34
	SVOC with TICs	Low	8270C	III	19/19	2/2	2/2	2/2					25/25
	TAL Metals	Low	6010/7470A	III	25/25	2/2			2/2	2/2			31/31
	Dissolved Metals	Low	6010/7470A	III	6/16	1/1			0/1	0/1			7/19
	Hardness	NA	SM6640B	I	25/25	2/2							27/27
	PCBs	Low	8082	III	19/19	2/2	2/2	2/2					25/25
	Pesticides	Low	8081	III	19/19	2/2	2/2	2/2					25/25
	Nitrate/Sulfate	NA	353.2/375.4	I	25/25	2/2							27/27
Groundwater													
GW - Temporary Wells/WPs	VOC (WPs incl. TICs)	Low	8260B	I	31/30	3/3					2/6	1/1	37/40
	1,4-dioxane	Low	5030C/8260B	I	31/30	3/3					2/6	1/1	37/40
	SVOC (WPs incl. TICs)	Low	8270C	I	2/2	1/0						1/1	4/3
	As, Cd, Pb, Fe, Mn, Mg	Low	6010/7470A	I	26/25	2/2							28/27
	TAL Metals (WPs)	Low	6010/7470A	I	5/5	1/1						1/1	7/7
	PCBs	Low	8082	I	2/2	1/0						1/1	4/3
	Pesticides	Low	8081	I	2/2	1/0	0/1	0/1				1/1	4/5
	Hardness	NA	SM6640B	I	26/25	2/2							28/27
GW - Existing MWs	VOC with TICs	Low	8260B	III	46/46	5/5	3/3	3/3			1/9	1/1	59/67
	1,4-dioxane	Low	5030C/8260B	III	46/46	5/5	3/3	3/3			1/9	1/1	59/67
	SVOC with TICs	Low	8270C	III	46/46	5/5	3/3	3/3				1/1	58/58
	Dissolved Metals	Low	6010/7470A	III	0/6	0/2							0/8
	TAL Metals	Low	6010/7470A	III	46/46	5/5			3/3	3/3		1/1	58/58
	MNA Parameters*	Low/Med	*	II	15/13	2/2							17/15
GW - New MWs	VOC with TICs	Low	8260B	III	15/15	1/1	2/2	2/2			3/4	2/2	25/26
	1,4-dioxane	Low	5030C/8260B	III	15/15	1/1	2/2	2/2			3/4	2/2	25/26
	SVOC with TICs	Low	8270C	III	5/5	1/1	2/1	2/1				1/1	11/9
	TAL Metals	Low	6010/7470A	III	15/15	1/1			2/3	2/3		2/2	22/24
	MNA Parameters	Low/Med	*	II	0/2	0/1							0/3
Sediment													
Sediment	VOC	Low/Med	5035/8260B	III	23/23	2/2	2/2	2/2			1/4	2/2	32/35
	SVOC	Low	8270C	III	23/23	2/2	2/2	2/2				2/2	31/31
	TAL Metals	Low	6010/7471A	III	25/25	2/2			2/2	2/2		2/2	33/33
	AVS/SEM	NA	EPA Draft Method	I	6/6	1/1							7/7
	PCBs	Low	8082	III	23/23	2/2	2/2	2/2				2/2	31/31
	Pesticides	Low	8081	III	23/23	2/2	2/2	2/2				2/2	31/31
	Grain Size	NA	Sieve ASTM C-117, C-136	NA	14/14	1/1							15/15
	pH	Low	9045C	I	9/9	1/1							10/10
	TOC	NA	Lloyd Kahn	I	23/23	2/2							25/25

Table 2-3

QA/QC Summary Table
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Medium/Matrix	Analytical Parameter	Concentration Level	Analytical Method	Data Evaluation - Tier Level	No. of Sampling Locations	No. of Field Duplicate Pairs	Organic		Inorganic		Expected No. of VOA Trip Blanks ⁽²⁾	No. of Equip. Blanks	Total No. of Samples
							No. of MS	No. of MSD	No. of Duplicates	No. of Spikes			
Soil													
Surface Soil	VOC	Low/Med	5035/8260B	III	22/22	3/2	2/1	2/1			1/6	2/2	32/34
	SVOC	Low	8270C	III	22/22	3/2	2/1	2/1				2/2	31/28
	TAL Metals	Low	6010/7471A	III	22/22	3/2			2/1	2/1		2/2	31/28
	PCBs	Low	8082	III	22/22	3/2	2/1	2/1				2/2	31/28
	Pesticides	Low	8081	III	22/22	3/2	2/1	2/1				2/2	31/28
	TOC	Low	Lloyd Kahn	I	22/22	4/2	0/1	0/1					26/26
	pH	Low	9045C	I	22/22	3/2	0/1	0/1					25/26
	Dioxins	Low	8280	III	4/4	1/1							5/5
Soil - Geoprobe	VOC	Med/High	8260B***	III	10/10	1/1	1/1	1/1			0/3	1/1	14/17
	PCBs	Low	8082	III	10/10	1/1	1/1	1/1				1/1	14/14
	Pesticides	Low	8081	III	10/10	1/1	1/1	1/1				1/1	14/14
	SVOC	Med/High	8270C	III	10/10	1/1	1/1	1/1				1/1	14/14
	TAL Metals	Med/High	6010/7471A	III	10/10	1/1			1/1	1/1		1/1	14/14
Soil - Landfill FS	Soil Strength	NA	Direct Shear ASTM D-3080	NA	5/4	1/1							6/5
	Grain Size	NA	Sieve ASTM C-117, C-136	NA	5/4	1/1							6/5
			Standard Proctor ASTM D 698										
	Moisture Density	NA		NA	5/4	1/1							6/5
Leachate													
Leachate	VOC	Med	8260B	I	2/2	1/0							3/2
	SVOC	Med	8270C	I	2/2	1/0							3/2
	TAL Metals	Med	6010/7470A	I	2/2	1/0							3/2
	PCBs	Med	8082	I	2/2	1/0							3/2
	Pesticides	Med	8081	I	2/2	1/0							3/2
Gas													
Landfill Gas	Percent Methane	%	(1)	NA	5/5	1/1							6/6
	Percent Oxygen	%	(1)	NA	5/5	1/1							6/6
	Hydrogen Sulfide	%	(1)	NA	5/5	1/1							6/6
	VOC	Low	TO-15	II	5/5	1/1							6/6

Notes:

Red numbers indicate actual numbers of samples collected and analyzed by the laboratory during Phase 1A (September 2004, including sampling of MW-22 couplet in March 2005) and Phase 1B (November 2005, including February 2006 sampling of MW-21, MW-24, and MW-25 couplets). This table does not reflect other 2006 sampling events (2006 Pre-ROD groundwater or surface water sampling, or the supplemental groundwater, surface water, sediment, or landfill gas sampling conducted from June 2006 to December 2006).

- (1) = measured in field with handheld instrument
- (2) = One per cooler with VOC samples
- NA = Not applicable
- As = Arsenic
- Cd = Cadmium
- Pb = Lead
- Fe = Iron
- Mg = Magnesium
- Mn = Manganese

*MNA Paramaters = Fe+2 (SM3500), sulfite (377.1), sulfide (376.1), methane (3810), DOC (415.1)

***Geoprobe VOC soil samples from soil borings SB-1 through SB-10 were analyzed based on either high or low concentration levels. SB-3,4,5,6 and 8 were analyzed at high concentration, while SB-1,2,7,9, and 10 were analyzed at low concentrations. The three trip blanks collected were analyzed at both high and low concentrations.

- AVS/SEM = Acid volatile sulfides/simultaneously extracted metals
- LF = Landfill
- PCB = polychlorinated biphenyl
- DOC = dissolved organic carbon
- SVOC = Semi-volatile organic compound
- TOC = Total organic compound
- VOC = Volatile organic compound
- GW = Groundwater

Table 2-4

**Summary of Well Viability Assessment
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Well Identification	Date Installed	Construction Material	Total Depth of Boring (ft)	Depth to Well Bottom (ft)	Well Screen Information		Measurements from October/November 2004							
					Depth (ft)	Length (ft)	DTW (ft bPVC)	DTB (ft bPVC)	FID (ppm)	PID (ppm)	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	H ₂ S (ppm)
Water table wells														
MW-1S	Jun-95	2-inch PVC	12	11	2-11	9	4.30	14.20		0.6	0.1	0	20.8	0
MW-2S	Jun-95	2-inch PVC	15	15	5-15	10	5.60	16.94		0	0	0.1	20.6	0
MW-3S	Jun-95	2-inch PVC	20	19	9-19	10	6.14	21.75		0	0	0.1	20.3	0
MW-6	Jun-95	2-inch PVC	22	15	5-15	10	5.95	17.92		0	0	0.1	20.4	0
MW-7S	Jun-99	2-inch PVC	10	10	0-10	10	4.02	12.63		0	0.5	0.2	20	0
MW-11S	Jan-01	2-inch PVC	54	14	4-14	10	2.22	15.80		1	0.5	0	20.4	0
MW-12	Jun-99	2-inch PVC	14	14	4-14	10	7.80	15.33		0	26.8	15.2	13.9	0
MW-13S	Feb-01	2-inch PVC	15	15	5-15	10	2.95	17.30		0.8	0.1	0	20.7	0
MW-17S	Feb-01	2-inch PVC	15	15	5-15	10	5.37	17.50		0.6	0	0	20.6	0
MW-19S	Jan-01	2-inch PVC	20	20	10-20	10	7.79	22.80		0	0	0.1	20.4	0
WES-01 (Perkins)	Aug-99	2-inch PVC	unknown	12	unknown	unknown	3.57	17.00	119.80	0	0	0	18.9	0
WES-04	Aug-99	2-inch PVC	unknown	11	unknown	unknown	4.84	16.40		0	0	0.2	20.3	0
WES-6	Aug-99	2-inch PVC	unknown	15	unknown	unknown	12.51	20.21		0	0	0.9	20.3	0
DEP-1	1999	unknown	unknown	unknown	unknown	unknown	1.04	NM	Unable to Locate	0.2	0.1	0	20.6	0
DEP-2	1999	unknown	unknown	unknown	unknown	unknown								
DEP-3	1999	unknown	unknown	unknown	unknown	unknown	NM	NM			0	0	0.1	20.4
Perkins Property Wells														
PMW-1	Apr-02	2-inch PVC	14	14	4-14	10	10.28	17.00	61.00		0	0	19.0	0
PMW-2	Apr-02	2-inch PVC	14	14	4-14	10	12.41	17.60	0		0	0	20.3	0
PMW-3	Apr-02	2-inch PVC	14	14	4-14	10	10.42	16.45	140.1		0	0	19.6	0
PMW-4	May-02	2-inch PVC	10	10	2-10	8	6.20	12.95	9.7		0	0	19.5	0
PMW-5	May-02	2-inch PVC	10	10	2-10	8	6.41	12.75	44.20		0	0	19.1	0
PMW-6	May-02	2-inch PVC	10	10	2-10	8	9.04	11.55	30.90		0.1	0	19.0	0
Intermediate Wells														
MW-4S	Jun-95	2-inch PVC	26	25	15-25	10	4.35	27.30		0	16.8	4.8	16.6	0
MW-5	Jun-95	2-inch PVC	32	25	15-25	10	4.25	27.05		0	10	0.8	18.8	0
MW-7M	Jun-95	2-inch PVC	25	25	15-25	10	3.50	27.43		27.5	49.7	6.1	10	0
MW-8M	Jun-99	2-inch PVC	57.5	30	20-30	10	2.41	33.03		0	0	0.2	20.1	0
MW-9	Jun-99	2-inch PVC	36	25	15-25	10	1.12	27.90		20.7	0	0.1	20.3	0
MW-10	Jun-99	2-inch PVC	27	25	15-25	10	3.20	27.95		0	17.4	0.2	16.1	0
MW-11	Jun-99	2-inch PVC	62	37	27-37	10	3.06	40.20		0.6	0.2	0	20.4	0
MW-11D	Jan-01	2-inch PVC	63	63	53-63	10	2.49	65.50		1.4	0.1	0	20.5	0
MW-13D	Jun-99	2-inch PVC	36	34	24-34	10	3.17	37.05		0.6	0.1	0	20.7	0
MW-14	Jun-99	2-inch PVC	52	48	38-48	10	3.38	51.50		0.6	0	0	20.7	0
MW-15	Jun-99	2-inch PVC	28	28	18-28	10	4.90	30.10		0	0	0.1	20.5	0
MW-16D	Jan-01	2-inch PVC	39	38	28-38	10	1.94	39.40		0.4	0.1	0	20.4	0
MW-17D	Feb-01	2-inch PVC	50	50	40-50	10	4.80	50.97		0.2	0.1	0	20.5	0
MW-18D	Jan-01	2-inch PVC	60	59	49-59	10	7.14	62.30		0	0	0.1	20.5	0
MW-19D	Jan-01	2-inch PVC	51	44	34-44	10	7.63	46.65		0	0	0.2	20.4	0
WED-02 (Perkins)	Aug-99	2-inch PVC	unknown	94	unknown	unknown	4.04	98.40	115.10		0.1	0	18.9	0
WED-05	Aug-99	2-inch PVC	unknown	31	unknown	unknown	4.95	38.95		0	0	0.4	20.2	0
WED-7	Aug-99	2-inch PVC	unknown	45	unknown	unknown	12.29	50.41		0	1.5	4.1	12.8	0

Table 2-4

**Summary of Well Viability Assessment
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Well Identification	Date Installed	Construction Material	Total Depth of Boring (ft)	Depth to Well Bottom (ft)	Well Screen Information		Measurements from October/November 2004							
					Depth (ft)	Length (ft)	DTW (ft bPVC)	DTB (ft bPVC)	FID (ppm)	PID (ppm)	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	H ₂ S (ppm)
Bedrock														
MW-1R	Jun-99	2-inch PVC	40	30	20-30	10	4.10	32.52		0	0	0	20.8	0
MW-2B	Jun-95	3-inch open hole	37	37	23-37	14	5.61	39.51		0	0	0.1	20.6	0
MW-3B	Jun-95	3-inch open hole	51.5	51.5	38-51.5	13.5	5.46	53.94		0	0	0.2	20.2	0
MW-4B	Jun-95	2-inch PVC	44	44	34-44	10	4.28	47.91		0	2.5	0.7	19.9	0
MW-7R	Jun-99	2-inch PVC	52	47	37-47	10	2.37	49.11		0	0	0	20.3	0
MW-8R	Jun-99	2-inch PVC	82	77	67-77	10	2.18	80.95		0	0	0	20.3	0
MW-13B	Feb-01	2-inch PVC	54.5	53.5	43.5-53.5	10	2.50	55.60		0.6	0.1	0	20.7	0
MW-16B	Jan-01	2-inch PVC	60	60	50-60	10	2.12	62.00		0.8	0.1	0	20.6	0
MW-17B	Feb-01	2-inch PVC	74	74	64-74	10	4.52	75.85		1.2	0.1	0	20.5	0
MW-18B	Jan-01	2-inch PVC	77	77	67-77	10	7.06	80.10		0	0	0.1	20.5	0
MW-19B	Feb-01	2-inch PVC	69	69	59-69	10	6.73	72.75	0	0	0.1	20.5	0	
WEB-03 (Perkins)	Aug-99	2-inch PVC	unknown	119	unknown		3.77	123.70	0		0.1	0	18.9	0
NOTES:														
1. Wells located on Perkins' Property were locked using Masterlock #A152 locks. All permanent wells at the Sutton Brook Disposal Area Site were locked using Masterlock #0344 locks. Town Wells (not shown here) were locked using Masterlock #2440.														
2. The Photoionization Detector (PID) was switched for a Flame Ionization Detector (FID) during the drilling program to alleviate interference issues (moisture, humidity, etc.). Because access to the Perkins property was not granted until mid-November (during the drilling program, after all other wells had been assessed), the field screening instrument being used at the site at that time and subsequently used during the well viability tasks on the Perkins Property was an FID.														
3. Those wells not installed before October/November 2004 are not included on this Well Viability Summary Table.														
ABBREVIATIONS:														
ft = feet below ground surface, except when referring to screen length														
PVC = polyvinyl chloride														
DTW = depth to water														
DTB = depth to bottom														
PPM = parts per million, volume														
CH ₄ = methane														
CO ₂ = carbon dioxide														
O ₂ = oxygen														
H ₂ S = hydrogen sulfide														
NM = not measured														

Table 2-5

**Wellhead Readings and Stabilized Field Chemistry Parameters - Temporary Wells
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Sample Location Identifier	Screened Interval (ft bgs)	Date Sampled	Intake Depth (ft bgs) *(ft btc)	Sample Method	Purged Volume (gal.)	Wellhead Readings						Stabilized Field Chemistry Parameters					
						PID (ppmV)	FID (ppmV)	% Methane	% Carbon Dioxide	% Oxygen	Hydrogen Sulfide (ppmV)	pH (S.U.)	Specific Conductance (mS/cm)	Temperature (°C)	ORP (mV)	Dissolved Oxygen (mg/l)	Turbidity (NTU)
DEP-4	unknown	09/15/99	14.5	NR	NR	NM	NM	NM	NM	NM	NM	5.92	0.234	13.58	-189	2.20	3.9
GP-01	2 - 12	11/11/04	8	LF-P	3.00	NM	NM	NM	NM	NM	NM	6.00	0.632	11.63	144	0.68	14.8
GP-02	2 - 12	10/14/04	10	LF-P	3.00	4.3	NM	0.2	0.8	20.8	NM	7.03	2.370	16.73	-123	0.26	43.5
GP-03	2.2 - 12.2	10/14/04	10.5	LF-P	1.75	15.6	NM	75.8	37.8	0.0	NM	6.78	3.520	14.81	-96	0.32	18.8
GP-04	3.4 - 13.4	10/14/04	11.5	LF-P	3.66	0.5	NM	0.3	1.1	20.1	NM	6.66	1.172	15.33	-90	1.57	16.1
GP-05	8 - 18	10/14/04	16	LF-P	2.25	0.0	NM	0.8	0.6	20.2	NM	6.56	2.060	14.40	-124	0.32	26.1
GP-06	8 - 18	10/14/04	16	LF-P	2.50	0.0	NM	0.3	0.5	20.2	NM	6.75	4.130	15.05	-120	0.39	5.11
GP-07	16 - 26	11/11/04	22	LF-P	2.25	NM	NM	NM	NM	NM	NM	6.38	3.270	11.39	159	0.37	16.2
GP-08	22 - 32	11/03/04	30	LF-P	1.75	NM	0.0	0.0	0.0	20.4	0	6.35	0.344	10.94	4	5.00	16.7
GP-09	10 - 20	11/11/04	15	LF-P	2.25	NM	NM	NM	NM	NM	NM	5.90	0.320	10.81	113	0.28	1.35
GP-10	8 - 18	11/02/04	14.5	LF-P	2.00	NM	0.0	0.0	0.0	20.6	0	5.44	0.151	11.23	-115	0.62	8.5
GP-11	7 - 17	11/02/04	15	LF-P	1.50	NM	750.6	0.1	0.0	20.7	0	5.73	3.520	12.14	-26	0.55	804
GP-12	3 - 13	10/21/04	10.5	LF-P	3.00	NM	IM	17.1	3.4	16.9	IM	6.42	0.429	12.32	-74	0.28	520
GP-13	5 - 15	10/21/04	12.5	LF-P	2.25	NM	IM	0.3	0.4	20.2	IM	6.17	1.454	12.33	-37	0.31	27.8
GP-14	3 - 13	10/21/04	11	LF-P	3.25	NM	4527	26.8	6.1	13.5	IM	6.09	0.648	12.39	-65	0.33	47.0
GP-15	6.7 - 16.7	10/21/04	12	LF-P	3.50	NM	3888	6.0	3.7	19.7	IM	6.34	0.432	11.94	-64	0.27	115.0
GP-16	10 - 20	10/21/04	13	LF-P	3.25	NM	2764	44.0	9.0	11.2	IM	6.24	0.383	11.52	-77	0.27	114.0
GP-18	19 - 24	11/04/04	21	LF-P	1.66	NM	1144	0.4	0.2	20.3	0	6.63	2.400	10.56	-86	0.45	23.4
GP-19	3 - 13	11/03/04	11	LF-P	1.75	NM	8.4	0.0	0.1	20.3	0	5.82	0.068	11.95	18	0.46	4.62
GP-20	14.5 - 24.5	11/23/04	23	LF-P	2.75	NM	143.3	0.1	0.0	19.2	0	5.43	0.250	9.80	310	0.50	17.5
GP-21	16.3 - 26.3	11/03/04	24	LF-P	1.25	NM	0	5.0	5.8	19.7	0	6.20	2.020	9.81	-65	0.34	12.8
GP-22	15 - 25	11/03/04	25	LF-P	2.25	NM	0.0	0.0	0.0	20.5	0	5.74	0.158	10.52	-24	0.34	39.8
GP-23	15 - 25	11/11/04	20	LF-P	3.00	NM	NM	NM	NM	NM	NM	6.13	0.274	10.47	96	2.50	11.9
GP-24	18 - 28	11/04/04	23	LF-P	2.40	NM	NM	NM	NM	NM	NM	6.76	0.880	10.06	-72	0.30	274
		06/08/06	25	LF-P	1.20	NM	NM	NM	NM	NM	NM	7.43	0.681	9.91	135	0.20	215
GP-25	15 - 25	11/11/04	20	LF-P	3.00	NM	NM	NM	NM	NM	NM	6.33	3.140	11.10	-235	0.25	3.69
		06/08/06	25	LF-P	3.00	NM	NM	NM	NM	NM	NM	7.27	4.060	10.47	131	0.40	1.93
GP-26	2 - 12	11/11/04	8	LF-P	3.25	NM	NM	NM	NM	NM	NM	5.59	0.372	11.90	255	0.42	145
WP-6	1.5-3.5	12/28/05	5.7*	LF-P	0.65	0.0	NM	NM	NM	NM	NM	6.92	0.362	5.00	-138	7.61	3.0
WP-7	8-10	12/28/05	10.5*	LF-P	0.4	1.7	NM	NM	NM	NM	NM	6.94	1.470	6.94	-252	0.57	14.0
WP-8	2-4	12/19/05	6*	LF-P	1.25	0.1	NM	NM	NM	NM	NM	5.17	0.325	5.64	-530	0.31	4.04
WP-9	1-3	12/28/05	5.5*	LF-P	0.8	0.9	NM	NM	NM	NM	NM	6.76	1.580	4.68	-243	0.38	9
WP-10	2-4	12/28/05	5.5*	LF-P	1.1	NM	NM	NM	NM	NM	NM	5.79	0.125	6.84	-209	0.29	1.1

NOTE:

All field chemistry measurements recorded prior to groundwater sample collection.

ft bgs = feet below ground surface

gal = gallons

°C = degrees Celsius

S.U. = standard units

mS = millisiemens per centimeter at 25°C.

mg/l = milligrams per liter

ORP = oxidation reduction potential

mV = millivolts

ntu = nephelometric turbidity unit.

LF-P = Well was sampled using low flow techniques and a peristaltic pump.

NR = Not Recorded

NM = Not measured

Table 2-7
Wellhead Readings and Stabilized Field Chemistry Parameters - Monitoring Wells
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Monitoring Well Identifier	Screened Interval (ft bgs)	Date Sampled	Intake Depth (ft bgs) *(ft btc)	Initial DTW (ft tpvc)	Final DTW (ft tpvc)	Sample Method	Flow Rate (ml/min)	Purged Volume (gal)	Wellhead Reading PID (ppmV)	Wellhead Reading Methane (% LEL)	Stabilized Field Chemistry Parameters						
											pH (S.U.)	Specific Conductance (mS/cm)	Temperature (°C)	ORP/Eh (mV)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (% saturation)	Turbidity (NTU)
MW-1S	2 - 11	06/95									6.10	2.400	11.70		NA		
		06/02/99	NR			LF-P or IL		1.6	NM		3.62	0.001	13.50	137.6	1.22	NM	NM
		09/14/99	28			LF-P		NR	NM		9.91	0.232	11.05	-337.3	0.2	NM	1.9
		03/13/01	NR			LF-P		NR	0.0		4.87	0.081	3.96	452	3.97	NM	1.6
		11/16/04	10	4.16	4.31	LF-P	180	3.7	0.6		5.50	0.190	9.69	-149	0.49	NM	24
MW-1R	20 - 30	09/14/99	10			LF-P		NR	NM		5.93	0.242	13.29	152.0	1.29	NM	0.02
		03/13/01	NR			LF-P		NR	NM		8.84	0.207	6.66	187.7	0.58	NM	0.83
		11/16/04	27	4.02	4.79	LF-P	275	2.7	0.0		8.14	0.202	9.76	-177	0.41	NM	8.8
MW-2A	5 - 15	06/95									6.60	3.660	17.20		2.00		
		07/02/99	NR			LF-P or IL		0.4	NM		6.13	0.080	20.40	-119.3	IM	NM	NM
		11/16/04	10	5.54	5.56	LF-P	300	3.8	0.0		6.74	2.560	11.33	-199	0.23	NM	13
MW-2B	23 - 37	06/95									7.20	1.820	13.70		3.50		
		07/07/99	NR			LF-P or IL		12	NM		8.78	0.017	15.30	62.5	2.22	NM	2.22
		11/16/04	30	5.6	9.48	LF-P	200	7	0.0		7.86	0.117	10.72	-180	0.32	NM	74
MW-3S	9 - 19	06/95									6.50	5.270	20.50		4.00		
		07/07/99	NR			LF-P or IL		0.7	NM		6.47	0.485	18.20	-131.4	0.41	NM	NM
		09/14/99	16.5			LF-P		NR	NM		6.65	3.905	19.13	-82.4	IM	NM	7.85
		09/16/99	16.5			LF-P		NR	NM		6.04	3.810	18.87	-78.2	6.07	NM	6.4
		11/16/04	14	6.29	6.32	LF-P	250	2.75	0.0		6.49	3.730	16.27	82	0.35	NM	4.36
		09/21/05	14	6.97	7.01	LF-P	400	2.5	2.8		6.36	4.800	17.03	-106	0.12	NM	3.93
		12/19/05	14	5.72	5.73	LF-P	250	2.7	1.0		6.57	2.660	13.92	-252	0.14	NM	3.18
		02/14/06	14	5.54	5.57	LF-P	200	2.4	0.3		6.39	2.520	13.85	10.00	0.14	NM	7.92
		06/06/06	14	5.46	5.48	LF-P	270	1.5	0.0		6.52	2.270	16.42	87.00	0.53	NM	3.25
MW-3B	38 - 51.5	10/04/06	14	6.60	6.61	LF-P	320	4.75	0.0		6.68	3.980	17.04	-127.00	0.20	NM	5.20
		06/95									8.00	2.000	20.00		NA		
		07/07/99	NR			LF-P or IL		12	NM		7.14	0.060	19.80	-201.1	2.02	NM	NM
		09/16/99	49			LF-GR		NR	NM		NM	NM	NM	NM	NM	NM	NM
		11/16/04	38	5.71	11.06	LF-P	100	1.8	0.0		6.95	0.288	14.66	-67	0.41	NM	6.11
		09/21/05	38	6.45	14.45	LF-P	100	3	0.0		7.03	0.232	17.21	-99	0.37	NM	9.30
		12/19/05	38	6.10	13.20	LF-P	100	3.6	0.0		7.71	0.186	12.40	-216	0.12	NM	22.1
		02/15/06	38	4.98	12.89	LF-P	75	3.9	0.0		7.38	0.199	15.24	-97.00	0.19	NM	27.1
		06/06/06	38	4.78	8.54	LF-P	80	1	0.0		7.64	0.188	18.99	-231.00	0.20	NM	79.8
MW-4S	15 - 25	10/04/06	44	5.97	12.77	LF-P	100	2.5	0.0		7.23	0.198	16.81	158.00	0.24	NM	12.2
		06/95									6.20	5.920	13.50		3.00		
		07/08/99	NR			LF-P or IL		0.6	NM		5.84	0.334	12.10	-91.2	6.08	NM	NM
		09/16/99	22.2			LF-P		NR	NM		5.89	6.751	12.47	-43.1	0.07	NM	4.9
		03/14/01	NR			LF-P		NR	11.1		6.09	6.607	7.97	5.7	0.73	NM	9.20
		11/15/04	25	4.98	6.08	LF-P	325	4	0.0		6.23	6.010	10.07	-203	0.27	NM	34.9
		09/20/05	20	5.76	6.41	LF-P	120	1.5	0.0		6.51	6.840	13.31	-72	0.63	NM	102
		12/15/05	20	4.67	5.70	LF-P	300	3.5	1.0		6.16	5.980	9.65	-75	0.30	NM	37.7
		02/15/06	20	4.55	5.70	LF-P	250	3.25	0.9		6.07	6.240	9.33	-14.00	0.11	NM	24.6
MW-4B	34 - 44	06/05/06	20	4.07	4.94	LF-P	200	1.75	0.0		6.62	5.380	10.79	100.00	0.50	NM	18.52
		10/04/06	20	5.35	6.32	LF-P	250	3.2	0.0		6.41	5.760	12.79	-102.00	0.19	NM	45.2
		06/95									6.60	3.920	12.70		1.50		
		07/08/99	NR			LF-P or IL		18	NM		6.21	0.307	15.00	-98.4	7.14	NM	NM
		09/14/99	40.7			LF-P		NR	NM		6.59	5.667	11.47	-103.9	IM	NM	19.79
		09/16/99	40.7			LF-P		NR	NM		6.55	5.076	11.68	-109.3	IM	NM	119
		03/14/01	NR			LF-P		NR	0.4		6.47	5.200	9.05	-65	0.94	NM	55
		11/15/04	43.5	5.16	6.34	LF-P	340	6.5	0.0		6.62	4.460	9.96	-207	0.29	NM	27.4
		09/20/05	39	5.57	5.99	LF-P	250	3.5	0.0		7.10	4.880	12.28	-78	0.61	NM	11.5
12/15/05	39	4.76	5.95	LF-P	300	4.5	0.0		6.54	4.210	9.59	-123	0.19	NM	9.0		
		02/15/06	39	4.67	7.36	LF-P	300	6.5	0.0		6.42	5.200	9.95	-16.00	0.03	NM	11.4
		06/05/06	39	4.32	5.97	LF-P	300	1.5	0.0		6.85	4.180	11.13	120.00	0.50	NM	7.82
		10/04/06	39	5.31	6.11	LF-P	320	5.0	0.0		6.64	4.560	11.98	124.00	0.50	NM	6.3

Table 2-7
Wellhead Readings and Stabilized Field Chemistry Parameters - Monitoring Wells
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Monitoring Well Identifier	Screened Interval (ft bgs)	Date Sampled	Intake Depth (ft bgs) *(ft btc)	Initial DTW (ft tpvc)	Final DTW (ft tpvc)	Sample Method	Flow Rate (ml/min)	Purged Volume (gal)	Wellhead Reading PID (ppmV)	Wellhead Reading Methane (% LEL)	Stabilized Field Chemistry Parameters						
											pH (S.U.)	Specific Conductance (mS/cm)	Temperature (°C)	ORP/Eh (mV)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (% saturation)	Turbidity (NTU)
MW-5	15 - 25	06/95									6.60	2.600	12.60		NA		
		07/08/99	NR			LF-P or IL		0.8	NM		6.37	0.308	14.70	-147.5	7.38	NM	NM
		11/15/04	24.5	4.95	13.35	LF-P	150	2.5	0.0		7.30	4.27	8.75	-195	0.77	NM	143.4
		09/20/05	24.5	5.97	11.60	LF-P	120	2	0.0		7.24	4.91	14.83	-79	0.59	NM	75
		12/14/05	24.5	4.71	13.70	LF-P	100	3	0.0		7.16	4.40	7.49	-179	1.30	NM	64.7
		02/14/06	24.5	4.07	8.82	LF-P	110	1.9	0.0		7.16	4.76	6.58	-51.00	0.13	NM	29.4
		06/05/06	24	3.86	7.10	LF-P	90	1	0.0		7.57	4.16	12.69	76.00	0.31	NM	26.11
MW-6	5 - 15	10/05/06	24.5	5.98	16.24	LF-P	100	4.45	0.0		7.17	3.52	14.18	-152.00	0.23	NM	67.8
		06/95									6.90	1.390	14.00		NA		
		07/07/99	NR			LF-P or IL		0.5	NM		6.56	0.216	15.20	-142.3	2.16	NM	NM
MW-7S	0 - 10	11/16/04	15	6.20	8.26	LF-P	200	2.4	0.0		6.52	1.365	13.25	-3	0.42	NM	51.6
		11/17/04	11	4.25	4.70	LF-P	170	2.5	0.0		6.68	0.809	8.01	19	0.22	NM	7.8
		10/03/06	7.5	5.05	5.37	LF-P	200	3.5	7.6	0.0	6.47	1.116	14.13	163.00	0.30	NM	9.0
MW-7M	15 - 25	06/95									6.10	2.690	17.80		2.60		
		06/02/99	NR			LF-P or IL		0.5	NM		5.66	0.058	13.50	-136.8	0.73	NM	NM
		11/17/04	24	5.44	6.02	LF-P	380	2.5	27.5		6.63	1.810	10.46	-33	0.15	NM	1.6
MW-7R	37 - 47	07/01/99				LF-P or IL		0.7	NM		10.26	0.006	15.50	-63.2	2.87	NM	NM
		11/17/04	46	3.00	10.90	LF-P	180	5	0.0		8.66	0.168	9.57	233	0.43	NM	2.3
MW-8M	20 - 30	09/16/99	NR			LF-P		NR	NM		6.78	1.820	12.52	-1129	0.56	NM	3.0
		03/13/01	NR			LF-P		NR	98.8		6.75	1.924	7.92	-96.1	1M	NM	12.06
		11/18/04	25	3.20	3.20	LF-P	250	2.9	0.0		6.67	2.880	9.84	-182	0.41	NM	9.0
MW-8R	67 - 77	09/16/99	75.5			LF-P		NR	NM		9.09	0.222	11.65	-213.4	0.16	NM	5.0
		03/13/01	NR			LF-P		NR	0.0		9.41	0.205	6.82	85.3	2.94	NM	0.85
		11/18/04	67	3.10	4.71	LF-P	225	3.4	0.0		9.12	0.203	10.14	-190	0.37	NM	2.43
MW-22M	26-36	03/17/05	31	3.10	3.10	LF-P	300	3.9	0.0		7.21	1.950	8.31	-41	0.13	NM	15.4
		09/21/05	31	3.65	3.65	LF-P	275	3.25	0.0		6.44	2.480	11.64	-36	0.61	NM	6.26
		12/15/05	31	3.26	3.28	LF-P	300	2	NM		6.40	2.500	8.86	-55	0.22	NM	1.22
		02/14/06	36.5	3.14	3.15	LF-P	250	6.8	0.0		6.47	2.610	9.16	-49.00	0.37	NM	5.2
		06/05/06	31	2.93	2.97	LF-P	340	3	0.0		6.85	2.290	10.23	114.00	0.40	NM	0.66
		10/03/06	31	3.41	3.43	LF-P	280	3	1.4		6.56	2.180	11.29	-95.00	0.12	NM	7.47
MW-22B	56-66	03/17/05	61	2.51	5.86	LF-P	300	8	0.0		7.78	0.164	9.13	-135	0.15	NM	6.51
		09/21/05	61	3.45	6.03	LF-P	250	2.5	0.0		6.76	0.181	11.40	-24	0.74	NM	28.2
		12/15/05	61	2.74	6.20	LF-P	325	4	NM		7.08	0.161	8.58	-50	0.26	NM	0.38
		02/14/06	65	2.65	6.87	LF-P	350	6.8	0.0		7.04	0.153	8.97	36.00	0.10	NM	4.1
		06/05/06	61	2.40	6.63	LF-P	360	3.75	0.0		7.61	0.161	10.02	109.00	0.22	NM	0.48
		10/03/06	61	3.04	6.00	LF-P	240	3.6	0.0		6.89	0.160	10.93	-65.00	0.12	NM	2.22
MW-9	15 - 25	09/17/99	23.5			LF-P		NR	14.0		5.80	1.436	16.87	8.3	8.60	NM	8.57
		11/17/04	25	1.71	1.88	LF-P	320	3.0	20.7		6.29	1.530	5.57	31	0.19	NM	19.9
		09/21/05	22	2.35	2.48	LF-P	225	4.5	15.9		5.57	2.280	15.08	-12	0.48	NM	11.4
		12/19/05	22	1.55	1.70	LF-P	300	3.75	74.0		5.35	2.040	8.33	-218	0.09	NM	4.57
		02/16/06	25	1.65	1.83	LF-P	225	4.5	5.8		5.48	2.110	8.92	114.00	0.34	NM	6.86
		06/08/06	22	1.05	1.27	LF-P	280	2.0	597		5.69	0.414	12.04	-82.00	0.18	NM	2.11
		10/03/06	23	1.99	2.20	LF-P	300	4.0	1501		5.53	2.240	14.02	146.00	0.35	NM	9.6
MW-10	15 - 25	03/15/01	NR			LF-P		NR	7.4		6.62	0.798	8.56	273.5	2.00	NM	10.6
		11/17/04	25	3.87	9.46	LF-P	180	3.25	0.0		7.23	0.429	10.72	142	0.12	NM	29.3
MW-11S	4 - 14	03/16/01	NR			LF-P		NR	0.9		6.80	1.620	7.94	-64.8	0.51	NM	8.5
		11/18/04	9	2.15	2.16	LF-P	175	2.5	1.0		6.73	0.410	11.71	-178	0.16	NM	99.1
		09/21/05	9	2.33	2.38	LF-P	300	2.75	0.0		6.49	0.485	15.69	-119	0.10	NM	4.0
		12/19/05	9	2.05	2.05	LF-P	225	1.75	0.0		5.76	0.635	9.72	-92	0.18	NM	6.96
		02/16/06	9	2.00	2.00	LF-P	300	5.2	0.0		6.74	0.773	9.57	-86.00	0.09	NM	4.41
		06/07/06	9	1.82	1.85	LF-P	200	1	0.0		6.76	0.370	10.60	-160.00	0.36	NM	8.5
		10/03/06	9	2.30	2.31	LF-P	225	2.75	0.0		6.83	1.030	14.15	99.00	0.27	NM	15.6

Table 2-7
Wellhead Readings and Stabilized Field Chemistry Parameters - Monitoring Wells
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Monitoring Well Identifier	Screened Interval (ft bgs)	Date Sampled	Intake Depth (ft bgs) *(ft btc)	Initial DTW (ft tpvc)	Final DTW (ft tpvc)	Sample Method	Flow Rate (ml/min)	Purged Volume (gal)	Wellhead Reading PID (ppmV)	Wellhead Reading Methane (% LEL)	Stabilized Field Chemistry Parameters						
											pH (S.U.)	Specific Conductance (mS/cm)	Temperature (°C)	ORP/Eh (mV)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (% saturation)	Turbidity (NTU)
MW-11	27 - 37	11/18/04	32	3.05	3.07	LF-P	150	2.5	0.6		6.63	2.380	10.98	-206	0.20	NM	110
		09/21/05	33.8	3.20	3.22	LF-P	300	2.75	0.0		6.39	3.24	12.19	-130	0.13	NM	8.0
		12/19/05	32	2.87	2.90	LF-P	275	2.5	0.1		5.38	2.98	9.50	-41	0.16	NM	4.46
		02/16/06	32	2.84	2.89	LF-P	500	7	0.0		6.66	3.12	10.45	-10.00	0.29	NM	1.37
		06/07/06	32	2.67	2.70	LF-P	275	3.5	0.0		6.64	2.85	10.85	-117.00	0.17	NM	7.56
		10/03/06	32	3.17	3.18	LF-P	300	5.75	0.0		6.72	3.48	11.87	164.00	0.37	NM	3.7
MW-11D	53 - 63	03/16/01	NR			LF-P		NR	3.2		7.10	0.697	9.56	-133.5	1.18	NM	9.81
		11/19/04	55	2.48	2.77	LF-P	200	3.8	1.4		7.32	0.318	11.21	-191	0.23	NM	3.3
MW-12	4 - 14	11/16/04	10	8.08	8.80	LF-P	300	2.6	0.0		6.33	2.200	12.52	-194	0.27	NM	12
		10/05/06	11	8.44	8.97	LF-P	315	3.5	0.0	100.0	6.53	3.300	14.95	112.00	0.37	NM	
MW-17S	5 - 15	03/15/01	NR			LF-P		NR	4.3		5.74	0.128	6.62	154.0	0.88	NM	2.05
		11/18/04	12.5	5.26	5.40	LF-P	540	5.25	0.6		6.45	0.257	11.65	73	0.17	NM	14.7
		09/21/05	12.5	5.47	5.45	LF-P	150	3	0.0		6.38	0.312	14.15	-20	0.51	NM	7.0
		12/15/05	12.5	5.35	5.37	LF-P	250	2.75	NM		6.32	0.224	8.91	-257	0.08	NM	9.83
		02/15/06	13	5.16	5.18	LF-P	450	3.5	0.0		6.27	0.265	8.56	83.00	0.06	NM	11.8
		06/06/06	12.5	5.01	5.01	LF-P	300	3.5	0.0		6.95	0.262	10.30	109.00	0.17	NM	7.35
		10/03/06	10	5.39	5.45	LF-P	440	5.5	0.0		6.34	0.240	13.00	-42.00	0.07	NM	9.8
MW-17D	40 - 50	03/15/01	NR			LF-P		NR	4.0		6.79	0.569	8.67	223.7	1.15	NM	2.55
		11/18/04	45	4.63	4.74	LF-P	420	4.5	0.2		6.74	0.559	10.16	229	0.14	NM	1.7
		09/21/05	45	4.88	4.94	LF-P	250	3.5	2.1		6.61	0.420	12.46	-27	0.58	NM	10.3
		12/15/05	45	4.73	4.83	LF-P	450	4.25	NM		6.66	0.529	8.26	-239	0.05	NM	0.81
		02/15/06	45	4.54	4.61	LF-P	400	5.5	0.5		6.75	0.584	9.31	48.00	0.06	NM	1.1
		06/06/06	45	4.35	4.46	LF-P	400	2.75	0.0		6.85	0.645	10.30	-37.00	0.16	NM	0.89
		10/03/06	45	4.77	4.88	LF-P	450	6.75	0.0		6.73	0.450	10.76	5.00	0.10	NM	2.32
MW-17B	64 - 74	03/15/01	NR			LF-P		NR	2.7		11.64	0.801	8.80	-620	1.02	NM	4.9
		11/18/04	70	4.41	9.04	LF-P	100	3.8	1.2		10.43	1.190	10.89	-372	0.33	NM	5.4
		09/21/05	70	4.80	9.70	LF-P	150	4	0.0		11.81	1.150	13.30	-140	1.03	NM	10
		12/15/05	70	4.45	8.60	LF-P	125	3	NM		11.95	1.028	7.04	-279	0.35	NM	1.33
		02/15/06	70	4.36	7.50	LF-P	100	2.5	1.0		11.64	1.187	9.16	-204.00	1.61	NM	0.8
		06/06/06	70	4.12	7.05	LF-P	200	2	0.0		11.21	1.291	11.39	-158.00	0.77	NM	2.69
		10/03/06	70	4.75	8.03	LF-P	110	2.6	0.0		11.75	1.442	14.17	-323.00	0.10	NM	10.5
MW-13S	5 - 15	03/15/01	NR			LF-P		NR	136.0		6.11	0.258	6.08	174.9	3.55	NM	0.29
		11/17/04	12	2.88	2.93	LF-P	275	3.6	0.8		6.19	0.381	10.45	-169	0.53	NM	2.22
		09/20/05	12	3.51	3.58	LF-P	325	3	0.0		6.06	0.422	11.84	-43	0.90	NM	2.4
		12/15/05	12.5	3.12	3.18	LF-P	250	2.2	NM		6.22	0.345	8.22	-219	0.52	NM	1.14
		02/14/06	12	2.94	3.02	LF-P	250	2.7	0.0		6.40	0.373	7.96	176.00	1.74	NM	0.33
		06/06/06	12.5	2.77	2.86	LF-P	340	3.5	0.0		6.23	0.583	10.51	-2.00	2.41	NM	0.76
		10/04/06	12	3.45	3.53	LF-P	325	3.6	0.0		6.34	0.419	12.80	230.00	0.65	NM	4.17
MW-13D	24 - 34	07/02/99	NR			LF-P or IL		1	NM		6.26	0.013	14.90	-76.9	5.48	NM	NM
		09/15/99	32			LF-P		NR	0.0		6.73	0.615	12.03	-56.6	3.27	NM	6.70
		03/15/01	NR			LF-P		NR	44.0		6.73	0.601	8.06	-36.7	1.43	NM	4.22
		11/17/04	29	3.09	3.11	LF-P	350	4	0.6		6.59	0.709	9.72	-187	0.70	NM	6.0
		09/20/05	29	3.66	3.66	LF-P	300	3.5	0.0		6.49	0.782	11.40	-131	0.22	NM	5.5
		12/15/05	29	3.30	3.32	LF-P	310	1.75	NM		6.58	0.703	8.24	-268	0.04	NM	1.28
		02/14/06	31	3.12	3.15	LF-P	275	4.5	0.0		6.61	0.657	9.17	176.00	0.08	NM	10.9
		06/06/06	29	2.92	2.95	LF-P	300	4	0.0		7.16	0.607	11.60	127.00	0.20	NM	3.39
		10/04/06	29	3.59	3.60	LF-P	360	5.6	0.0		6.75	0.643	11.86	6.75	0.10	NM	8.3
MW-13B	43.5 - 53.5	03/15/01	NR			LF-P		NR	94.1		11.91	1.130	7.57	-229	1.25	NM	3.0
		11/17/04	48	2.41	3.92	LF-P	150	3.2	0.6		9.38	0.169	9.64	-163	1.03		39
		09/20/05	48	3.05	3.75	LF-P	300	3.75	0.0		9.82	0.218	11.22	-155	0.29	NM	3.3
		12/15/05	48	2.52	4.44	LF-P	160	2.5	NM		9.57	0.185	7.70	-275	0.12	NM	7.45
		02/14/06	48	2.31	5.60	LF-P	150	8.5	0.0		8.68	0.222	8.74	141.00	0.11	NM	172
		06/06/06	48	2.10	4.97	LF-P	250	3.75	0.0		8.42	0.232	11.31	-21.00	0.44	NM	8.76
		10/04/06	48	2.87	5.11	LF-P	200	2.9	0.0		9.14	0.236	12.48	223.00	0.23	NM	173

Table 2-7
Wellhead Readings and Stabilized Field Chemistry Parameters - Monitoring Wells
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Monitoring Well Identifier	Screened Interval (ft bgs)	Date Sampled	Intake Depth (ft bgs) *(ft btc)	Initial DTW (ft tpvc)	Final DTW (ft tpvc)	Sample Method	Flow Rate (ml/min)	Purged Volume (gal)	Wellhead Reading PID (ppmV)	Wellhead Reading Methane (% LEL)	Stabilized Field Chemistry Parameters						
											pH (S.U.)	Specific Conductance (mS/cm)	Temperature (°C)	ORP/Eh (mV)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (% saturation)	Turbidity (NTU)
MW-14	38 - 48	09/15/99	45.7			LF-P		NR	0.0		6.76	0.751	11.48	-75.3	1.64	NM	7.95
		11/17/04	45	3.30	3.47	LF-P	400	2.9	0.6		6.89	0.553	9.82	-188	0.22	NM	5.1
MW-15	18 - 28	07/07/99	NR			LF-P or IL		0.3	NM		6.89	0.031	17.20	-138.6	1.18	NM	NM
		09/15/99	25.3			LF-P		NR	NM		6.88	0.155	14.16	-84.3	0.80	NM	15.2
		11/15/04	23	4.67	6.46	LF-P	275	2.7	0.0		6.74	0.142	11.56	62	0.57	NM	43.4
		12/08/04	23	4.24	5.76	LF-P	220	4	NM		6.98	0.144	11.09	253	0.51	NM	32.0
MW-16D	28 - 38	03/16/01	NR			LF-P		NR	IM		6.93	0.803	8.66	-18	1.16	NM	8.7
		11/18/04	33	1.87	1.88	LF-P	360	3	0.4		6.91	0.502	9.71	-31	0.19	NM	0.96
MW-16B	50 - 60	03/16/01	NR			LF-P		NR	IM		12.19	5.037	8.27	-75.3	0.72	NM	1.69
		11/18/04	56	2.27	7.09	LF-P	100	3.8	0.8		10.45	1.840	9.12	229	2.59	NM	1.65
MW-18D	49 - 59	03/14/01	NR			LF-P		NR	IM		7.02	0.181	7.92	-35.6	2.29	NM	6.13
		11/16/04	50	7.24	10.66	LF-P	200	3.9	0.0		7.75	0.143	9.09	-188	0.39	NM	4.3
MW-18B	67 - 77	03/14/01	NR			LF-P		NR	IM		12.27	1.830	8.14	-4.4	2.70	NM	1.67
		11/17/04	67	7.19	7.87	LF-P	200	4.2	0.0		9.08	0.125	9.18	-162	0.54	NM	79.2
MW-19S	10 - 20	03/14/01	NR			LF-P		NR	1.0		5.58	0.142	5.80	245	1.42	NM	0.5
		11/15/04	15	7.67	7.74	LF-P	300	2.75	0.0		5.53	0.171	10.55	47	0.41	NM	0.90
MW-19D	34 - 44	03/14/01	NR			LF-P		NR	3.0		7.40	0.085	7.11	-210.0	1.28	NM	5.72
		11/15/04	34	7.67	8.71	LF-P	250	3.3	0.0		7.20	0.097	9.61	12	0.36	NM	2.78
MW-19B	59 - 69	03/14/01	NR			LF-P		NR	1.1		12.53	3.711	5.95	-219.2	0.86	NM	0.60
		11/15/04	65	6.68	8.80	LF-P	175	4.4	0.0		11.56	0.592	9.52	15	0.65	NM	6.61
MW-21	2 - 12	12/08/04	7	2.92	2.97	LF-P	330	5.25	NM		5.05	0.083	8.26	245	0.43		3.8
		12/13/05	7	3.30	3.34	LF-P	325	2.75	0.0		4.58	0.700	4.83	39	2.26	NM	1.03
MW-21M	15 - 25	12/08/04	20	3.05	3.22	LF-P	300	4.25	NM		5.32	0.970	9.42	278	0.32		16.1
		12/13/05	20	3.47	3.65	LF-P	325	3.5	0.0		4.68	0.069	5.79	49	4.62	NM	4.5
MW-23B	48-58	12/08/04	55	8.60	8.71	LF-P	150	2	NM		8.45	0.124	9.65	-146	0.63		30.8
		09/20/05	55	10.60	10.85	LF-P	200	2.5	0.4		7.40	0.138	12.41	-37	0.80	NM	1.11
		12/14/05	55	8.54	8.89	LF-P	300	3.75	0.0		8.00	0.134	8.62	-149	1.31	NM	0.46
		02/14/06	55	8.05	8.42	LF-P	400	5	0.0		7.67	0.149	8.97	199.00	0.12	NM	1.78
		06/07/06	55	7.63	7.91	LF-P	300	4.5	0.0		8.50	0.154	9.52	97.00	0.12	NM	2.86
		10/05/06	58	9.75	9.97	LF-P	230	4.25	0.0		7.78	0.133	10.62	292.00	0.15	NM	2.22
PMW-6	NA	06/04/02	9.5			LF-P		NR	0.1		6.84	0.814	10.93	257	5.08		0.05
		09/20/05	11.5	11.31	dry	LF-P	NM	0	0.0		NM	NM	NM	NM	NM	NM	NM
		12/14/05	11.5	7.96	8.34	LF-P	360	4.5	0.0		6.65	0.488	8.49	-86	4.92	NM	0.70
		02/14/06	11.5	6.69	6.88	LF-P	275	2.6	0.0		6.08	0.351	5.85	216.00	2.16	NM	1.90
		06/07/06	11.5	5.41	5.50	LF-P	225	1.75	0.0		7.16	0.266	10.62	122.00	3.21	NM	2.47
		10/05/06	11	10.47	dry	LF-P	min	0	0.0		NM	NM	NM	NM	NM	NM	10.5
MW-24	3-13	12/14/05	11	6.78	6.87	LF-P	300	4	0.0		6.22	0.055	8.62	-11	9.97	NM	3.0
		02/09/06	11	5.85	5.98	LF-P	300	2.3	NM		4.79	0.615	6.69	256	9.37	NM	1.10
MW-24M	19.5-29.5	12/14/05	26	7.83	7.91	LF-P	275	5	0.0		5.90	0.372	9.51	-89	0.39	NM	6.20
		02/09/06	26	7.40	7.50	LF-P	250	3.7	NM		5.66	0.374	9.66	252	0.78	NM	1.8
MW-25	10-20	12/13/05	17.5	13.69	13.95	LF-P	180	3	0.1		5.60	0.471	10.95	111	8.35	NM	1.03
		02/09/06	17.5	11.18	11.32	LF-P	200	1.5	NM		4.61	1.147	9.69	284	7.14	NM	0.6
MW-25M	23-33	12/14/05	30.5	16.22	16.61	LF-P	300	5	3.2		5.68	0.651	11.62	113	7.56	NM	1.74
		02/09/06	30.5	15.44	15.61	LF-P	200	2.9	NM		5.24	1.068	10.35	260	7.48	NM	0.6
DEP-4	unknown	09/15/99	14.5					NR	NM		5.92	0.234	13.58	-189	2.20	NM	3.9
WES-1	unknown	09/13/99	12			LF-P		NR	NM		6.64	0.078	12.62	221	NM	72.1	2.97
		11/22/04	15			LF-P		2.25	NM		5.99	0.041	10.74	358	3.79	NM	10.0
WED-2	unknown	09/13/99	93.6			LF-P		NR	NM		9.77	0.213	10.47	501.5	NM	1.7	1.47
		11/22/04	80			LF-P		4.75	NM		10.59	0.566	10.05	257	0.68	NM	15.9
WEB-3	unknown	09/13/99	118.7			LF-P		NR	NM		10.34	0.224	10.55	563.4	NM	2.8	2.26
		12/08/04	80			LF-P		12	NM		10.86	0.154	9.67	50	0.75	NM	1.84
		01/05/05	80			LF-P		10.75	NM		10.05	0.155	8.72	-148	0.78	0.8	0.12
WES-4	unknown	09/13/99	11.2			LF-P		NR	NM		6.28	0.150	14.70	8.8	NM	1.8	1.76
		11/15/04	14			LF-P		3.75	0.0		6.06	0.292	9.92	-153	0.70	NM	22.1
WED-5	unknown	09/13/99	31			LF-P		NR	NM		6.40	0.215	10.78	-16.6	NM	0.8	4.0
		11/15/04	36			LF-P		5.5	0.0		6.13	0.270	9.30	-169	0.44	NM	21.0

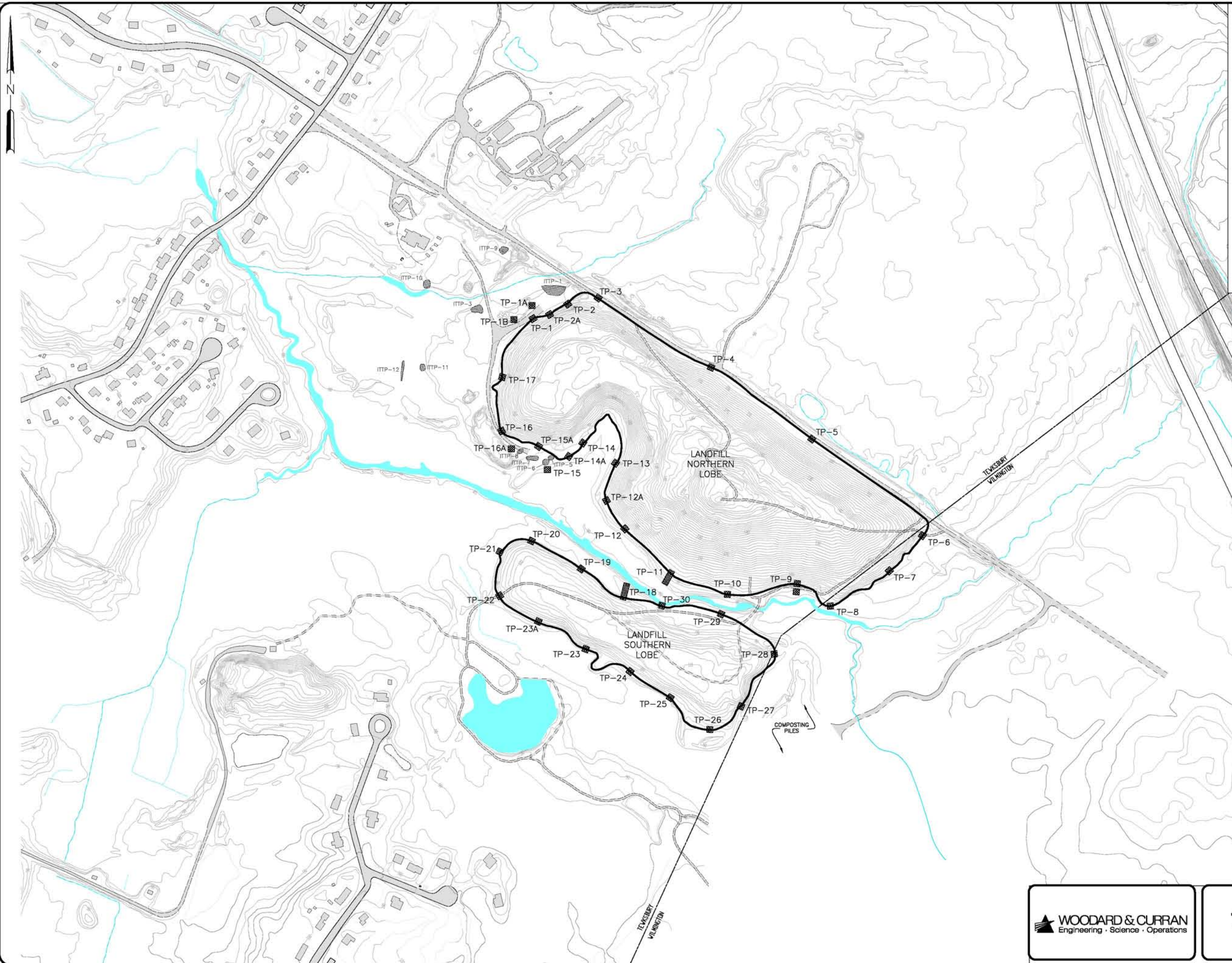
Table 2-7
Wellhead Readings and Stabilized Field Chemistry Parameters - Monitoring Wells
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Monitoring Well Identifier	Screened Interval (ft bgs)	Date Sampled	Intake Depth (ft bgs) *(ft btc)	Initial DTW (ft tpvc)	Final DTW (ft tpvc)	Sample Method	Flow Rate (ml/min)	Purged Volume (gal)	Wellhead Reading PID (ppmV)	Wellhead Reading Methane (% LEL)	Stabilized Field Chemistry Parameters						
											pH (S.U.)	Specific Conductance (mS/cm)	Temperature (°C)	ORP/Eh (mV)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (% saturation)	Turbidity (NTU)
WES-6	unknown	09/15/99	15.4			LF-P		NR	NM		6.16	0.514	14.33	83.5	0.18	NM	11.8
		11/16/04	15			LF-P		2.2	0.0		6.18	1.159	12.33	31	0.33	NM	12.2
WED-7	unknown	09/15/99	45			LF-P		NR	NM		6.48	0.848	11.81	41.2	0.12	NM	2000
		11/16/04	45			LF-P		1.9	0.0		6.70	1.610	10.48	-19	0.64	NM	23.8
WP-6	1.5-3.5	12/28/05	5.7*	2.37	5.70	LF-P	65	0.65	0.0		6.92	0.362	5.00	-138	7.61	NM	3.0
WP-7	8-10	12/28/05	10.5*	1.29	6.57	LF-P	70	0.4	1.7		6.94	1.470	6.94	-252	0.57	NM	14.0
WP-8	2-4	12/19/05	6*	2.06	2.16	LF-P	75	1.25	0.1		5.17	0.325	5.64	-530	0.31	NM	4.04
WP-9	1-3	12/28/05	5.5*	2.30	4.47	LF-P	75	0.8	0.9		6.76	1.580	4.68	-243	0.38	NM	9
WP-10	2-4	12/28/05	5.5*	2.08	4.03	LF-P	80	1.1	NM		5.79	0.125	6.84	-209	0.29	NM	1.1
PMW-1	4 - 14	04/18/02	13			LF-P		NR	<1		6.39	4.037	9.79	-168	0.96	NM	3.1
		06/04/02	11.5			LF-P		NR	1.5		6.28	4.212	11.58	21	0.52	NM	1.87
		11/22/04	13			LF-P		2.35	NM		6.37	0.957	12.39	177	0.39	NM	4.40
PMW-2	4 - 14	04/18/02	13			LF-P		NR	0.9		6.21	1.515	9.77	48	0.77	NM	3.4
		12/08/04	14			IL		1.5	NM		NM	NM	NM	NM	NM	NM	68
		01/05/05	14			IL		1.5	NM		NM	NM	NM	NM	NM	NM	104
PMW-3	4 - 14	04/18/02	13			LF-P		NR	2.0		5.97	1.251	7.90	52	0.30	NM	1.9
		11/23/04	12			LF-P		3.5	NM		6.21	1.394	11.72	51	0.25	NM	2.9
PMW-4	2 - 10	06/04/02	7			LF-P		NR	1.4		6.86	1.638	12.52	105	2.84	NM	0.05
		06/13/02	7			LF-P		NR	NM		6.89	2.026	12.30	156	6.37	NM	0
		11/09/06	7	5.88	5.90	LF-P	300	3.5	NM		7.41	0.764	11.00	19	6.21	NM	2.8
PMW-5	2 - 10	06/04/02	7			LF-P		NR	0.5		7.36	1.029	11.96	253	IM	NM	0.05
<div>NOTE:</div> <div>All field chemistry measurements recorded prior to groundwater sample collection.</div> <div>NR = Not reported (historical data).</div> <div>NM = Not measured</div> <div>IM = Instrument malfunction</div> <div>ft bgs = feet below ground surface; ft btc = feet below top of casing</div> <div>gal = gallons</div> <div>Blank Space = Not measured</div> <div>PID = Photoionization detector</div> <div>mg/l = milligrams per liter</div> <div>ppmV = parts per million by volume</div> <div>°C = degrees Celsius</div> <div>S.U. = standard units</div> <div>mS = millisiemens per centimeter at 25°C.</div> <div>ORP/EH = Redox potential</div> <div>mV = millivolts</div> <div>NTU = nephelometric turbidity unit</div> <div>LF-P = Well was sampled using low flow techniques and a peristaltic pump.</div> <div>IL = Well was sampled via Inertial Lift (HDPE or LDPE with checkvalve).</div>																	

Table 2-8
Summary of Pre-ROD Monitoring and Sampling Program
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site – Tewksbury, Massachusetts

Sampling Location	Rationale	Requested Parameter				Change from Previous Program (Reason for Change)
		VOCs	Metals	SVOCs	Field Chemistry	
Groundwater						
MW-3S	Adjacent to Northern Lobe	S	S		S	Q to S (Minimal to no seasonal variation)
MW-3B	Adjacent to Northern Lobe	S	S		S	Q to S (Minimal to no seasonal variation)
MW-4S	Adjacent to Southern Lobe	S	S	S	S	Q to S (Minimal to no seasonal variation)
MW-4B	Adjacent to Southern Lobe	S	S	S	S	Q to S (Minimal to no seasonal variation)
MW-5	Adjacent to Southern Lobe	S	S	S	S	Q to S (Minimal to no seasonal variation)
MW-22M	Downgradient of Southern Lobe	S	S			Q to S (Minimal to no seasonal variation)
MW-22B	Downgradient of Southern Lobe	A	A		A	Q to A (Consistently low to non-detect)
MW-9	Former Drum Disposal Area	S	S	S	S	Q to S (Minimal to no seasonal variation)
MW-11S	Downgradient of Former Drum Disposal Area	S	S	S	S	Q to S (Minimal to no seasonal variation)
MW-11	Downgradient of Former Drum Disposal Area	S	S	S	S	Q to S (Minimal to no seasonal variation)
MW-17S	Downgradient Site Perimeter	S	S			Q to S (Minimal to no seasonal variation)
MW-17D	Downgradient Site Perimeter	S	S			Q to S (Minimal to no seasonal variation)
MW-17B	Downgradient Site Perimeter	A	A		A	Q to A (Consistently low to non-detect)
MW-13S	Downgradient Site Perimeter	S	S	S	S	Q to S (Minimal to no seasonal variation)
MW-13D	Downgradient Site Perimeter	S	S	S	S	Q to S (Minimal to no seasonal variation)
MW-13B	Downgradient Site Perimeter	A	A		A	Q to A (Consistently low to non-detect)
PMW-6	Upgradient	A	A		A	Q to A (Consistently low to non-detect)
MW-23B	Upgradient	A	A		A	Q to A (Consistently low to non-detect)
Surface Water						
SW-30	Upstream	S	S			No Change (S remains appropriate)
SW-33	Between Landfill Lobes	S	S			No Change (S remains appropriate)
SW-36	Adjacent to Former Drum Disposal Area	S	S			No Change (S remains appropriate)
SW-37	Downstream	S	S	S		No Change (S remains appropriate)
NOTES				S		
VOCs = volatile organic compounds by EPA Method 8260B, including 1,4 Dioxane				S		
Metals = metals by EPA Method 6000/7000 series				S		
SVOCs = semi-volatile organic compounds by EPA Method 8270C				S		
Field chemistry parameters = ph, specific conductance, dissolved oxygen, ORP, and turbidity						
Q = quarterly;						
S = semi-annually: Spring (High Water) and Fall (Low Water);						
A = annually: Fall (Low Water)						

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Sutton Brook Disposal Area
Date: 11/11/17
User: J. Woodard



LEGEND

TP-5 TEST PIT LOCATION AND IDENTIFIER (W&C 2004)
ITTP = TEST PIT INSTALLED BY IT CORPORATION

APPROXIMATE EDGE OF LANDFILL LOBE

PAVED ROAD
 UNPAVED ROAD

WATER
 BUILDING

NOTES:

1. THE TOPOGRAPHIC AND PLANIMETRIC FEATURES AS SHOWN PROVIDED BY THE TOWN OF TEWKSBURY, MASSACHUSETTS, DEPARTMENT OF PUBLIC WORKS, AND ARE BASED UPON AERIAL PHOTOGRAMMETRIC MAPPING COMPLETED BY JAMES W. SEWALL COMPANY OF OLD TOWN, MAINE FROM AERIAL PHOTOGRAPHS DATED MARCH 29, 1985. THE MAP IS REPORTED TO MEET NATIONAL MAP ACCURACY STANDARDS FOR 1"=100' MAPS WITH 2 FOOT CONTOURS. WOODARD & CURRAN HAS NOT FIELD VERIFIED AND IS NOT RESPONSIBLE FOR ACCURACY OF SAME.

2. THE GROUND SURFACE TOPOGRAPHIC VERTICAL DATUM REFERENCED IS EXPRESSED IN FEET AND BASED UPON THE USGS NORTH AMERICAN VERTICAL DATUM OF 1929 (NAVD29), AS ESTABLISHED BY OTHERS.

3. THE SURVEY DATA AS PRESENTED ON THIS PLAN WAS CORRECT AT THE TIME THIS PLAN WAS PRODUCED. ANY AND ALL DATA IS SUBJECT TO CHANGE WITH TIME AND WE ASSUME NO RESPONSIBILITY FOR THE USE OF INCORRECT OR OUTDATED INFORMATION. FOR VERIFICATION OR UPDATE OF SURVEY DATA FOR THIS SITE CONTACT WOODARD & CURRAN. WOODARD & CURRAN HAS NOT CONDUCTED PROPERTY BOUNDARY OR EASEMENT SURVEYS.

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FIGURE 2-1

TEST PIT LOCATIONS

SUTTON BROOK DISPOSAL AREA

\\woodard\projects\110117 Sutton Brook\Map Drawings\110117-02.dwg
DATE: 11/11/11
DRAWN BY: J. WOODARD
CHECKED BY: J. WOODARD
SCALE: 1"=100'

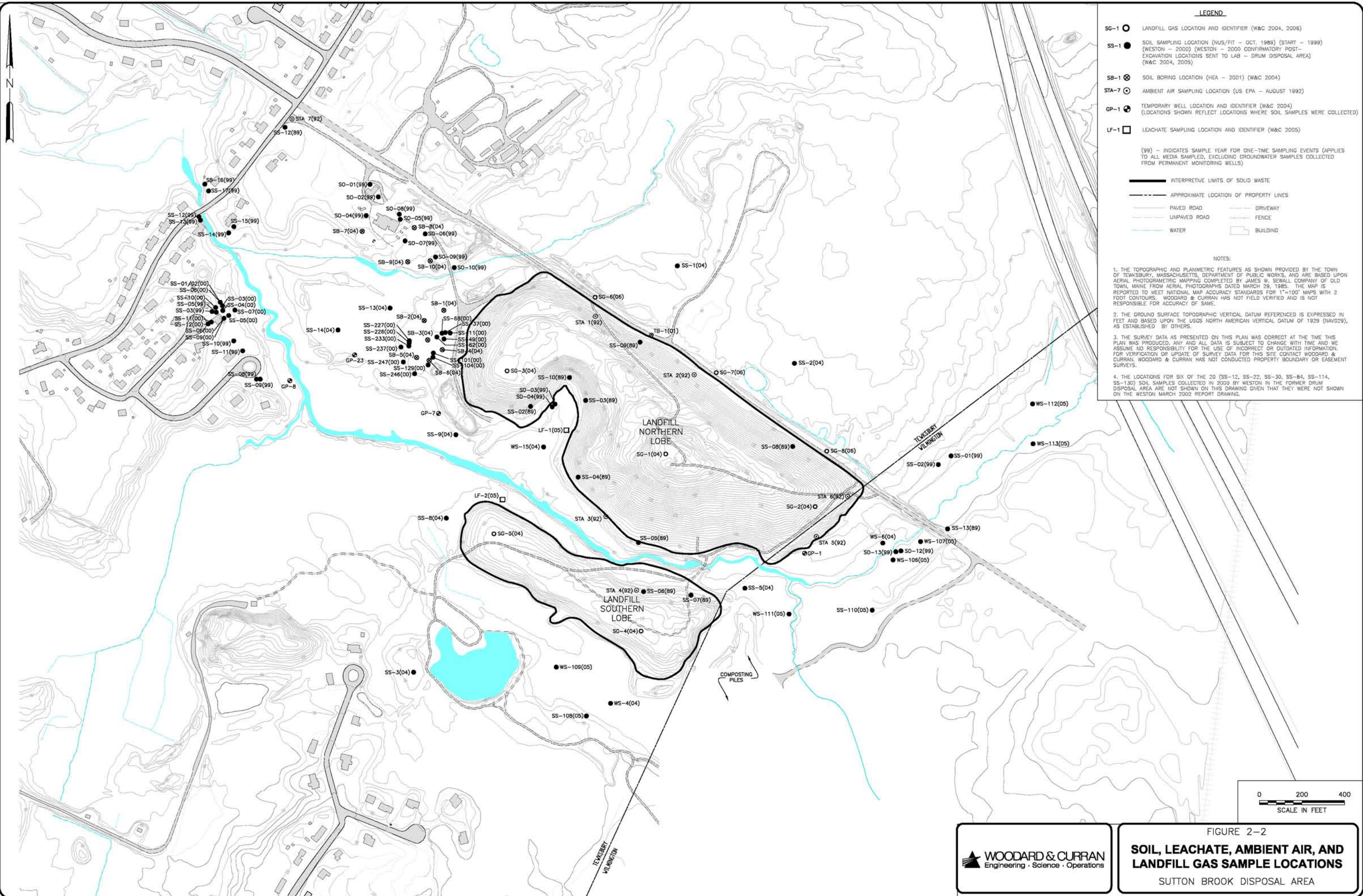
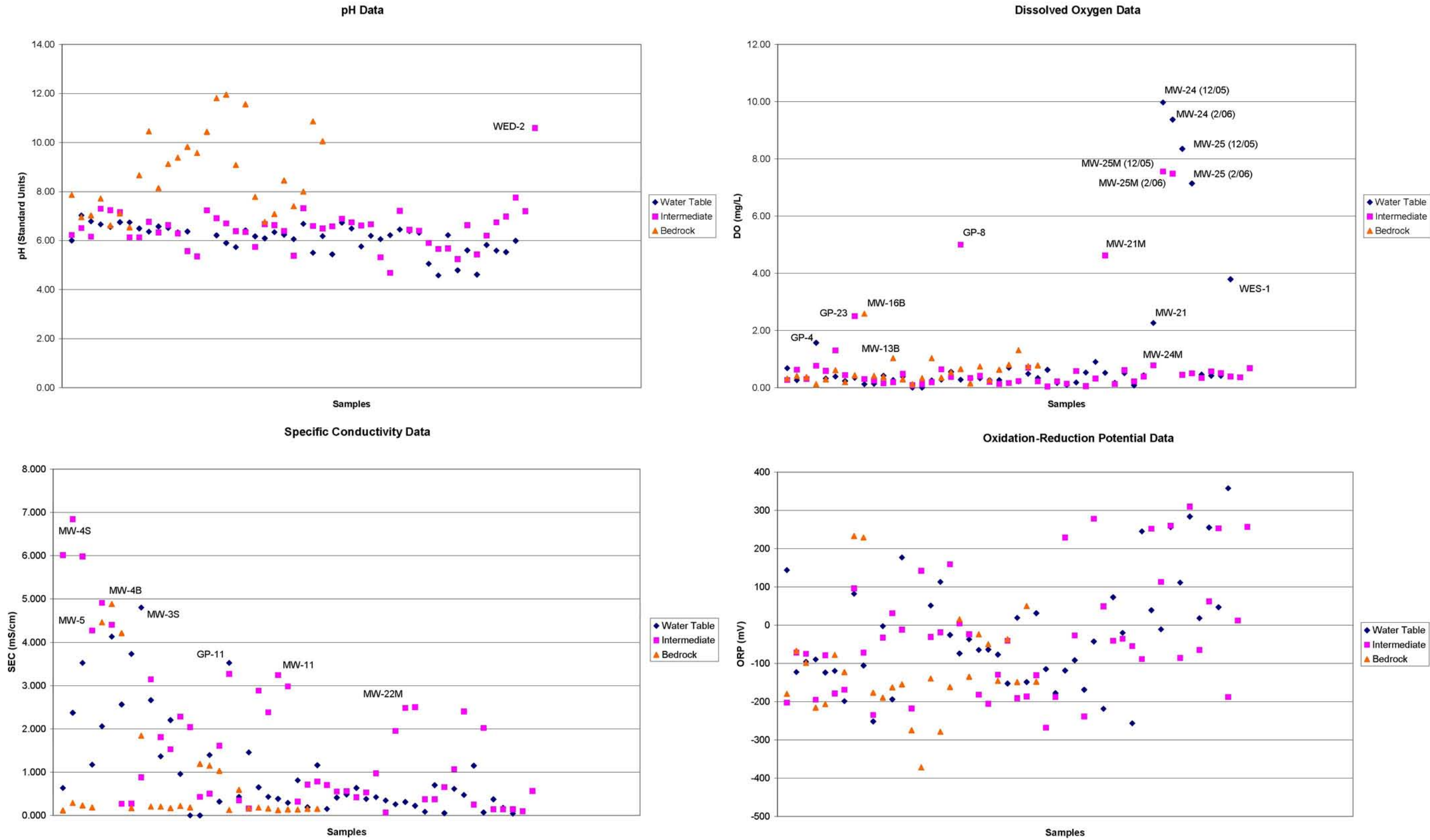


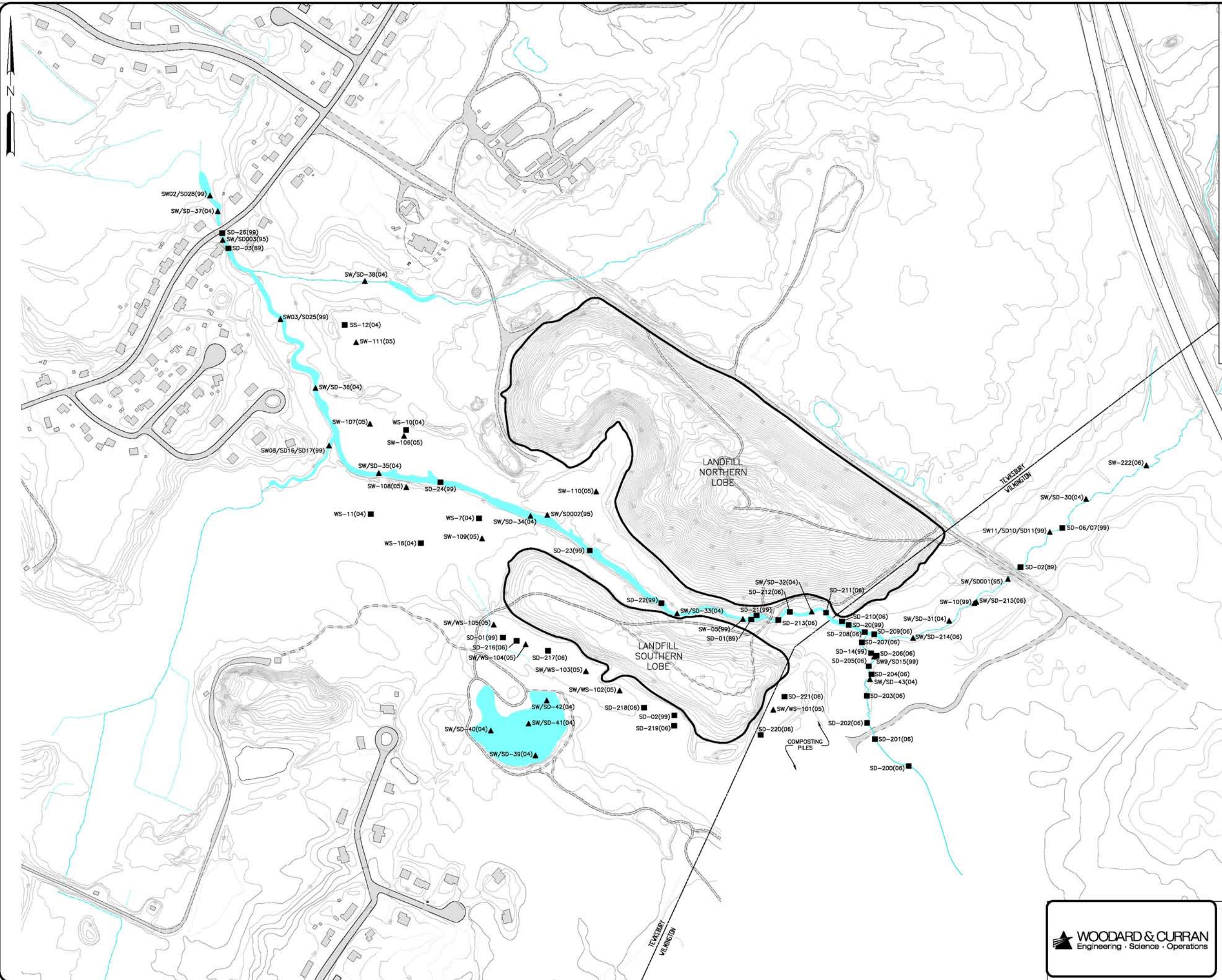
Figure 2-4

Summary of Field Chemistry Data - Groundwater
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts



Note:
1. Data represents field chemistry measurements taken during groundwater sampling events from October 2004 - December 2005 (and includes data collected from MW-24/24M and MW-25/25M in February 2006)

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DATE: 01/11/17
TIME: 10:00 AM
USER: woodard
PROJECT: Sutton Brook Disposal Area



LEGEND

SW/SD-33 ▲ SURFACE WATER AND SEDIMENT SAMPLING LOCATION (METCALF & EDDY - 1995) (START - 1999) (W&C 2004, 2005, 2006)

SD-23 ■ SEDIMENT OR AQUATIC WETLAND SAMPLING LOCATION (NUS/FIT - OCT, 1989) (START - 1999) (M&E - 1995) (W&C 2004, 2005, 2006)

(99) - INDICATES SAMPLE YEAR FOR ONE-TIME SAMPLING EVENTS (APPLIES TO ALL MEDIA SAMPLED, EXCLUDING GROUNDWATER SAMPLES COLLECTED FROM PERMANENT MONITORING WELLS)

— INTERPRETIVE LIMITS OF SOLID WASTE

- - - APPROXIMATE LOCATION OF PROPERTY LINES

PAVED ROAD DRIVEWAY

UNPAVED ROAD FENCE

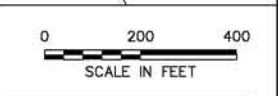
WATER BUILDING

NOTES:

1. THE TOPOGRAPHIC AND PLANIMETRIC FEATURES AS SHOWN PROVIDED BY THE TOWN OF TEWKSBURY, MASSACHUSETTS, DEPARTMENT OF PUBLIC WORKS, AND ARE BASED UPON AERIAL PHOTOGRAMMETRIC MAPPING COMPLETED BY JAMES W. SEWALL COMPANY OF OLD TOWN, MAINE FROM AERIAL PHOTOGRAPHS DATED MARCH 29, 1985. THE MAP IS REPORTED TO MEET NATIONAL MAP ACCURACY STANDARDS FOR 1"=100' MAPS WITH 2 FOOT CONTOURS. WOODARD & CURRAN HAS NOT FIELD VERIFIED AND IS NOT RESPONSIBLE FOR ACCURACY OF SAME.

2. THE GROUND SURFACE TOPOGRAPHIC VERTICAL DATUM REFERENCED IS EXPRESSED IN FEET AND BASED UPON THE USGS NORTH AMERICAN VERTICAL DATUM OF 1929 (NAVD29), AS ESTABLISHED BY OTHERS.

3. THE SURVEY DATA AS PRESENTED ON THIS PLAN WAS CORRECT AT THE TIME THIS PLAN WAS PRODUCED. ANY AND ALL DATA IS SUBJECT TO CHANGE WITH TIME AND WE ASSUME NO RESPONSIBILITY FOR THE USE OF INCORRECT OR OUTDATED INFORMATION, FOR VERIFICATION OR UPDATE OF SURVEY DATA FOR THIS SITE CONTACT WOODARD & CURRAN. WOODARD & CURRAN HAS NOT CONDUCTED PROPERTY BOUNDARY OR EASEMENT SURVEYS.





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FIGURE 2-5

**SURFACE WATER AND
SEDIMENT SAMPLE LOCATIONS**

SUTTON BROOK DISPOSAL AREA



3. REMEDIAL INVESTIGATION LABORATORY ANALYTICAL DATA

The usability of the environmental data collected as part of the Remedial Investigation (RI) was assessed through a quantitative and qualitative review of the sampling program and data results. The mechanism for this review is described in detail in the project-specific Quality Assurance Project Plan (QAPP) prepared for the site (W&C, 2004). The overall objective of the QA program for the RI is to establish procedures to monitor the integrity of the field data and laboratory analytical results such that the data obtained from the field and laboratory analyses are of adequate quality to satisfy the project objectives. The site-specific project quality objectives (PQOs) were described in Section 7.0 of the QAPP and consisted of a set of qualitative and quantitative statements that specified the quality of the data required to support the decisions made during the RI/FS.

This section is broken into three subsections. Section 3.1 provides a general discussion of the usability of the data (both historic and newly collected). Section 3.2 presents an evaluation of the data to the precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS) parameters. Section 3.3 provides a general presentation of the data.

3.1 DATA USABILITY

Assessing the data usability involves the processes of reviewing laboratory data for each medium and assessing whether it meets the prescribed PQOs developed in the QAPP. The “data” includes both historic or pre-RI data as well as the data collected during the RI.

The following information was reviewed to determine the “usability” of the available historic or existing site data:

- sample collection methods to ensure appropriate sample collection methods were used;
- laboratory analytical methods to ensure samples were analyzed following standard analytical methods and would be comparable to data to be collected during the RI;
- data documentation (e.g., laboratory data sheets, boring logs, etc.); and
- data validation records to ensure data is usable for its intended purpose.

A summary of specific reports, data collection events, and data that have been determined “usable” for the RI was previously presented in Section 2. These data were determined to be generally comparable with the requirements of the project specific QAPP and are suitable for their intended end use in the RI. Historic (or existing) data validation codes applied to these data, were transferred with the data without additional data evaluation or review, with the exception of “U” coded data. Review of the historical data presentation indicates that most of the U codes were not actual validation codes, but rather were applied to indicate a non-detect result. It is likely that a small percentage of those non-detect results were originally detected results that were subsequently converted to non-detect results upon validation. For consistency with the 2004-2006 dataset, the historic U coded data are presented as non-detect results, without qualification. It should be noted that this modification to the data presentation does not change the usability of these non-detect results.

Newly collected analytical data (2004-2006), was evaluated by comparing quality control results to criteria outlined in tables located in Section 7 and Section 13 of the QAPP. Where no guidance is available from these tables, the Region I, EPA-New England Data Validation Functional Guidelines for Evaluating Environmental Analyses (EPA, 1996) and the Region I Tiered Organic and Inorganic Data Validation Guidelines (EPA, 1993) were used.

Data collected at the Site during the RI were validated according to Tier I, Tier II, or Tier III validation procedures, as indicated in Table 3-1. The level of data validation required for each type of data collected is specific to the project data quality objectives specified in Section 7 of the QAPP.



Table 3-1 Data Validation Requirements by Sample Type

Sample Description	Media	Tier I	Tier II	Tier III
Existing Wells & New Monitoring Wells ⁽¹⁾	Groundwater	X*	X*	X
Temporary Wells ⁽²⁾	Groundwater	X		
Surface Water	Surface Water	X***		X
Sediment	Sediment	X**		X
Surface Soils	Soil	X**		X
Geoprobe Soil	Soil			X
Landfill Gas (VOCs)	Air		X	
Leachate	Leachate	X		

⁽¹⁾ = Consists of samples collected from locations designated as monitoring wells (i.e., MW-24M).

⁽²⁾ = Consists of samples collected from locations designated as geoprobe wells (i.e., GP-14) and wellpoints (i.e., WP-8).

*Monitored natural attenuation parameters were validated at Tier I/II; all other analyses were validated at Tier III.

**TOC, AVS/SEM, and pH were validated at Tier I; all other parameters were validated at Tier III.

***Hardness, Nitrates, and Sulfates were validated at Tier I; all other analyses were at Tier III.

The Tier I evaluation procedure included a completeness check of the laboratory and field documentation. The Tier II validation process included a review of tabulated quality control results and comparison against EPA Region I evaluation limits and/or project specific criteria included in the QAPP to identify bias or other interferences that could affect the quality of sample results. This will result in proper qualifiers being applied to the data. Specific quality control components evaluated in the Tier II review include the following:

- Data completeness check
- Holding times
- Sample preservation measurements
- Blank results
- Initial and continuing calibration results
- Surrogate standard results
- Matrix spike/Matrix spike duplicate results
- Laboratory and Field duplicates
- Laboratory control sample results
- Internal standard results
- Gas Chromatography/Mass Spectrometry and Gas Chromatography/Electron Capture Detector (GS/MS and GC/ECD) tuning results
- Inter-element interferences on metals concentrations
- Serial dilution results



The Tier III validation procedure included a review of all components listed above for the Tier II procedure. However, the Tier III procedure was a more detailed review that included an examination of raw data to evaluate analyte identification and quantification rather than a review of only tabulated results as with the Tier II process.

For each sample delivery group, data validation reports prepared by the independent data validator are provided in Appendix H. The objective of these reports is to provide a usability assessment of the data by making known and quantifying, where applicable, the uncertainty in the data such that the end user is aware of potential biases, false positives, and false negatives in the analytical data. Qualifiers were applied to the data during the usability assessment process to flag these uncertainties. Data that are unqualified or qualified with a “U” (not detected), a “J” (estimated), or a “UJ” (estimated quantitation limit) are usable for project decisions including assessment of risk. Data qualified with an “R” (rejected) are unusable, as the level of uncertainty in the value is unacceptable for basing project decisions or risk calculations. Overall, data qualified with an “R”, accounted for approximately 5% of the total dataset (including both previous and newly collected data). The sediment dataset represents the media with the highest percentage of rejected data. Most commonly, this resulted from the sampled media exhibiting percent solids above the QAPP criteria. Alternative sampling methods were employed during the investigations (as described in Section 2); however, due to the physical characteristics of the sediments in some locations (high organic and peat contents), the required percent solids could not be obtained. Other less prevalent issues resulting in rejection of data included failure to meet either initial/continuing calibration criteria. A summary of the usability of both historic (i.e. pre-RI/FS Workplan) and newly collected data as part of the RI investigation activities is presented below.

3.1.1 Soil & Sediment

The soil and sediment data groups consist of the following investigation activities:

- October 1989: 11 upland soil and 3 sediment samples
- June – October 1995: 3 sediment samples
- August – September 1999: 6 wetland soil; 26 upland soil; and 23 sediment samples
- September – October 2000: 12 upland soil samples
- April – May 2002: 7 upland soil samples
- October – November 2004: 14 upland soil; 10 wetland soil; and 20 sediment samples (landfill soil samples were not included as they were not analyzed for chemical constituents)
- November – December 2005: 2 upland soil; 6 wetland soil; and 5 sediment samples
- November 2006: 22 sediment samples

In general, the soil and sediment data were of sufficient quality to be used in the RI, exceptions are noted below.

Historic and Existing Site Data (Pre-RI/FS Workplan)

A review and assessment of the usability of the historic data (1989 through 2002) indicated that this data meets the performance criteria and data usability for the RI program with the exception of data that was originally rejected. Soil and sediment data from 1989 resulted in the rejection of silver in each of the 11 soil and 3 sediment samples analyzed. No soil or sediment data was rejected as part of the 1995 sampling program. In 1999, rejected data primarily was the result of high moisture content present in a subset of soil and sediment samples. As a result, the non-detect Volatile Organic Compound (VOC) results reported for 6 sediment samples were rejected (detected results were retained as estimated – “J” qualified). Additionally, the following constituents were rejected due to poor laboratory quality control results:



- VOCs [2-Butanone (1 soil and 3 sediment samples) and Acetone (1 soil and 1 sediment sample)];
- Pesticides [4,4'-DDT (9 soil samples), Heptachlor Epoxide (6 soil and 1 sediment sample), 4,4'-DDD and Endrin (4 soil samples each), alpha-Chlordane and Endrin Aldehyde (3 soil samples each), Aldrin and Dieldrin (1 soil sample each)]; and
- Metals [Antimony (17 soil and 1 sediment sample), Cadmium (1 soil sample), and Cyanide (2 sediment samples)].

Of the 12 soil samples analyzed in 2000, VOCs [2-Butanone, Dibromochloromethane, Styrene, and Bromoform (7 samples) and Pesticides [alpha-Chlordane and Heptachlor Epoxide (1 sample)] were rejected due to poor laboratory quality control results.

The remaining qualifications to the historic data set were generally due to the reporting of detected concentrations below the laboratory's reporting limit (J qualifications), although U codes and UJ qualifications were also applied. The data validation codes applied to these data, were transferred with the data without additional data evaluation or review with the exception of "U" coded data. Review of the historical data presentation indicates that most of the U codes are not actual validation codes, but rather were applied to indicate a non-detect result. It is likely that a small percentage of those non-detect results were originally detected results that were subsequently converted to non-detect results upon validation (likely as a result of blank contamination). For consistency with the 2004-2006 dataset, the historic U coded data are presented as non-detect results, without qualification. It should be noted that this modification to the data presentation does not change the usability of these non-detect results.

RI/FS Data (2004 – 2006)

The results of the usability assessment for the newly collected 2004 - 2006 RI soil and sediment samples indicated that the furnace atomic absorption recoveries, internal standard and Inductively Coupled Plasma (ICP) and serial dilution results all indicated acceptable results, without qualification.

The results indicated no qualifications were applied to the organic results based on data completeness, GC/MS and GC/ECD instrument performance check, laboratory control sample results, and target compound identification. For inorganic results, no qualifications were applied based on data completeness, preservation and technical holding times, calibration verification, laboratory control sample results, serial dilution results, and sample quantitation.

Approximately 7.2% of the soil and approximately 5.7% of the sediment data was qualified as estimated (J) due to the reporting of detected concentrations below the laboratory's reporting limit, low internal standard recoveries, or not meeting percent recovery or Relative Percent Difference (RPD) criteria. Additionally, in one sample, the positive Semivolatile Organic Compound (SVOC), pesticide, and Polychlorinated Biphenyl (PCB) results were qualified as estimated (J) as a result of a minor holding time exceedance. Although the exceedance of this holding time resulted in qualified results, this exceedance is unlikely to have had a significant affect on the reported results. SVOCs, pesticides and PCBs are generally very stable compounds and should not have experienced significant degradation during this short exceedance of sample hold-time.

Data qualified as non-detect (U) or non-detect with an estimated reporting limit (UJ) were generally qualified due to blank contamination, although low internal standard recoveries, compounds not meeting the initial and continuing calibration criteria (primarily for VOC and SVOC analyses), and four MS/MSD samples not meeting percent recovery or RPD criteria also resulted in J and UJ qualifications. Additionally, a limited number of matrix interferences (primarily in sediment samples) within ICP serial dilutions also resulted in J and UJ qualifications.

All sample quantitation and reporting quantitation limits were adjusted, accordingly, based on percent solids. The results of the moisture/solid content analysis had a significant impact on the usability of the



soil and sediment data. During the 2004-2006 soil/sediment sampling events, approximately 9% of soil data and 32% of sediment data were qualified as rejected, “R”. More specifically, 76% of the rejected soil data and 97% of the rejected sediment data resulted from qualification of non-detect results due to the low percentage of solids (less than or equal to 30% and greater than or equal to 10%) in the sampled media. Additionally, approximately 32% of positive soil results and 57% of the positive sediment results were estimated (J qualified) as a result of the same issue with the low percentage of solids.

The majority of rejected data comprised two sediment sampling events (November 2005 and November 2006). These data were all non-detected constituents reported in the analyses for 11 sediment samples (5 samples in November 2005 and 6 samples in November 2006) and were rejected in accordance with current USEPA Region 1 guidance. The next most common reason for rejection of soil and sediment results was extremely low internal standard recovery for VOC samples.

Similar to the samples collected in 1999 (by M&E), all sediments in the area South and East of the Southern Lobe (the Deep Marsh), with the exception of SD-220, contained low percent solids (less than 30%). The shrub and forested wetland that comprises the Deep Marsh contains a thick layer of soft, highly organic peaty sediment characteristic of wetland environments. Samples typically contained about 15% solid material, which is normal for wetlands and slow-moving streams. In consequence, the sediment samples contain a high percentage of moisture, which cannot be removed in the field by conventional techniques. In discussions with EPA, it was agreed to stay with the current sampling methods of collecting extra volume to compensate for the low percent solids in place of changing methods at this time in the investigation (e.g., switching to a freeze drying method). As indicated previously, the extra volume facilitated the analyses of the samples with lower percent solids for all parameters except VOCs.

EPA Region I Functional Guidelines (1996) governing data validation define sediment by the same criteria used to define soils, which is containing greater than 30% solids. As part of an aquatic system, many shallow sediments from quiescent water bodies do not meet this soils-based definition. As a result and in accordance with the EPA 1996 guideline, all detected compound results are flagged as estimated (J) and non-detected compound results (e.g., reporting limits) are flagged as rejected (R).

However, under EPA’s National Functional Guidelines (2001) such data would be considered acceptable for use. These guidelines do not require sediments to meet the solids content of soils, and thus do not require the rejection of data from sediments with moisture content typical of sediments.

With the addition of the six samples collected in 2006, the Deep Marsh is represented by 13 sediment samples, which provides adequate coverage of sample variability. Based on the total solids results detected in these samples over the three separate sampling events and the intended use of the data, the R-flagged data (non-detects, mainly for VOCs) are considered to be representative of non-detected compounds at the reporting limits, with the understanding that these values are estimates. This is the same approach used for J-flagged data, which is used throughout the risk assessment.

In summary, aside from the moisture content issue with sediment collected from the Deep Marsh, the overall quantity and quality of the soil and sediment data were of sufficient quality to meet the intended end use as described in the QAPP.

3.1.2 Groundwater & Surface Water

The aqueous data groups consist of the following investigation activities:

- June – October 1995: 10 groundwater samples from monitoring wells and 3 surface water samples
- June – July 1999: 26 groundwater samples from monitoring wells and 4 surface water samples



- August – September 1999: 6 groundwater samples from temporary well locations, 14 groundwater samples from monitoring wells, and 9 surface water samples
- March 2001: 22 groundwater samples from monitoring wells
- April – June 2002: 10 groundwater samples from monitoring wells
- October 2004 – March 2005 (Phase 1A RI): 24 groundwater samples from temporary well locations; 51 groundwater samples from existing and newly installed monitoring wells, and 14 surface water samples
- September 2005 – October 2006 (Pre-ROD Monitoring and Sampling): 90 groundwater samples (one sample from 18 existing and newly installed monitoring wells on 5 occasions: September 2005, December 2005, February 2006, June 2006, and October 2006), and 12 surface water samples (one sample from four separate locations on three occasions: September 2005, February 2006, October 2006)
- December 2005 – February 2006 (Phase 1B RI): 10 groundwater samples from newly installed monitoring wells, 5 groundwater samples from temporary well points, and 11 surface water samples
- June – November 2006 (Supplemental Groundwater Sampling): 12 groundwater samples from existing monitoring wells and 2 groundwater samples from temporary well locations (for MNA analysis), and 1 groundwater sample from existing monitoring well PMW-4 (in response to EPA comment)
- November 2006 (Supplemental Ecological Risk Sampling): 3 surface water samples

In general, the groundwater and surface water data were of sufficient quality to be used in the RI, exceptions are noted below. Similar quality control parameters were used to assess aqueous sample results including laboratory and field quality control samples.

Historic and Existing Site Data (Pre-RI/FS Workplan)

The results of the usability assessment for the historic data set indicated that all of the data are usable with the exception of a few groundwater samples collected in September 1999 and March 2001. All the historic surface water data was deemed usable.

In summary, rejected groundwater data collected in September 1999 were the result of poor laboratory quality control results which resulted in the rejection of data associated with one sample analyzed for VOCs, SVOCs, metals, PCBs, and pesticides. Additional qualifications to another sample resulted in rejected data for a few individual constituents (heptachlor epoxide, cadmium, and nickel). March 2001 groundwater data was rejected from 4 samples due to sampling error (primarily sample effervescence) and additional data was rejected due to low Laboratory Fortified Blank (LFB) recoveries. In both instances the results were rejected as potential false negatives.

The remaining qualifications to the historic groundwater and surface water data were generally due to the reporting of detected concentrations below the laboratory's reporting limit (J qualifications) with additional qualifications (U and UJ) likely attributable to blank contamination and noncompliant relative percent difference results, respectively.

RI/FS Data (2004 – 2006)

Groundwater – Temporary Wells

The assessment of temporary well groundwater data was validated at the Tier I/completeness check level (geoprobe locations such as GP-1, GP-2, etc.) and at the Tier III level (wellpoint locations such as WP-6, WP-8, etc.). The Tier I check resulted in the data being usable for its intended use. The Tier III



validation indicated no qualifications were applied to the organic results based on data completeness, preservation and technical holding times, GC/MS and GC/ECD instrument performance check, initial calibration results, blank results, surrogate compounds, internal standards, MS/MSD results, laboratory control sample results, laboratory and field duplicates, target compound identification, and sample quantitation and reported quantitation limits. For inorganic results, no qualifications were applied based on data completeness, preservation and technical holding times, calibration verification, ICP ICS results, matrix spike recoveries, laboratory and field duplicates, laboratory control sample results, serial dilution results, and sample quantitation. With the exception of a very low percentage of rejected results (R qualified) described below, all associated organic and inorganic data are usable for project decisions, with certain qualifications summarized below.

Approximately 0.04% of the wellpoint data were qualified as estimated (J) due to results detected at concentration below the laboratory's reporting limit (primarily VOCs and metals), poor continuing calibration results (VOCs), or missed technical hold times. Approximately 0.01% of the non-detect results were qualified as estimated (UJ) due to non-compliant continuing calibration results (VOCs). Less than 0.01% of the data was qualified as undetected (U) as a result of blank contamination (metals). Less than 0.01% of the data was also qualified as rejected (R) as a result of non-compliant initial calibration results (VOCs).

Groundwater – Monitoring Wells

The Tier III validation and usability assessment on the remaining groundwater data (a total of approximately 164 samples collected over 8 separate sampling events conducted between September 2004 and November 2006) indicate no qualifications were applied to the organic results based on data completeness, GC/MS and GC/ECD instrument performance check, internal standards, laboratory control sample results, and target compound identification. For inorganic results, no qualifications were applied based on data completeness, laboratory control sample results, serial dilution results, and sample quantitation. With the exception of a very low percentage of rejected results (R qualified) described below, all associated organic and inorganic data are usable for project decisions, with certain qualifications summarized below.

Approximately 3.5% of the groundwater data were qualified as estimated (J) due to results detected at concentrations below the laboratory's reporting limit (primarily VOCs and metals), preservation and technical holding times (VOCs and metals), poor initial or continuing calibration results (VOCs), high surrogate recovery (VOCs), spike recoveries and MS/MSD results outside acceptance criteria (VOCs), field duplicates outside acceptance criteria (VOCs), sample quantitation and reported quantitation limits (VOCs), calibration verification (metals), and matrix interference in the ICP ICS (metals). Approximately 2% of the non-detect groundwater data were qualified as estimated (UJ) due to compounds not meeting preservation and technical holding time (VOCs and metals), not meeting initial or continuing calibration criteria and failed MS/MSD recovery (VOCs and SVOCs), low surrogate recoveries (VOCs, SVOCs and pesticides), calibration verification (metals), and matrix interference in the ICP ICS (metals). Approximately 1% of the groundwater data were qualified as undetected (U) due to blank contamination (VOC and metals). Rejected groundwater results also accounted for approximately 1% of the data. Data were rejected due to preservation and technical holding time violations and initial or continuing calibration issues (VOCs), matrix interference in the ICP ICS (metals).

Surface Water

The results of the surface water sample usability assessment indicated no qualifications were applied to the organic results based on data completeness, GC/MS and GC/ECD instrument performance check, internal standards, laboratory control sample results, and laboratory and field duplicates. For inorganic results, no qualifications were applied based on data completeness, preservation and technical holding times, laboratory control sample results, serial dilution results, and sample quantitation. With the



exception of a very low percentage of rejected results (R qualified) described below, all associated organic and inorganic data are usable for project decisions, with certain qualifications summarized below.

Approximately 5% of the surface water data were qualified as estimated (J) due to results detected at concentrations below the laboratory's reporting limit (VOCs and metals), preservation and technical holding times (VOCs), poor initial or continuing calibration criteria (VOCs), spike recoveries or MS/MSD results outside acceptance criteria (VOCs and metals), target compound identification (VOCs), calibration verification (metals), sample quantitation and reported quantitation limits (VOCs and SVOCs) and field duplicates outside acceptance criteria (metals). Approximately 3% percent of the non-detect surface water data were qualified as estimated (UJ) due to compounds not meeting initial or continuing calibration criteria (VOCs and SVOCs), failed Matrix Spike recovery (VOCs), spike recoveries or MS/MSD results outside acceptance criteria (VOCs), interference in the ICP ICS (metals), and preservation and technical holding times (pesticides). Approximately 2% of the surface water data were qualified as undetected (U) due to blank contamination (VOC and metals). The only data to be rejected were the acrolein results, which were rejected in most of the surface water samples due to the RRF in the initial or continuing calibration not meeting the criteria, representing approximately 0.4% of the surface water data.

Overall the quantity and quality of the groundwater data and surface water data were of sufficient quality to meet the intended end use as described in the QAPP.

As required by EPA and described in the QAPP (Section 6), the laboratory was required to perform a GC/MS library search to identify Tentatively Identified Compounds (TICs) present in water samples analyzed for VOCs and SVOCs. The majority of the TICs identified were characterized as "Unknown", and therefore did not match library spectra well. The TIC screening process described in the QAPP has been used to determine if there is an indication that additional site-related compounds not addressed by the standard target compound analysis may be present and therefore warrant further possible review. The results of this screening evaluation are presented in Table 3-2. As indicated on this table and consistent with the QAPP, most compounds were screened out for the following reasons:

- Compound represented less than 5% of the individual data sets for groundwater and surface water were screened out since infrequent detection provides a high degree of uncertainty as to whether TIC should be considered a potential site contaminant;
- Compounds identified as "Unknown" were screened out since no evaluation is possible without tentative identification;
- Compound was reported in another method's target analyte list (for example: 1,4-dioxane was reported as a TIC in some aqueous samples following Method 8270C; however 1,4-dioxane was also reported as the target analyte for the 8260-SIM method analysis); and
- Specific health based screening criteria does not exist for the compound.

As a result of this screening, two compounds (chlorodifluoromethane and N,N-dimethylformamide) detected in groundwater samples were retained for further evaluation in the Risk Assessment. No TICs were retained from any of the surface water samples.

3.1.3 Landfill Gas

The landfill gas data set is comprised of the three landfill gas samples collected in June 1995 and five landfill gas samples collected in October 2004. These samples were analyzed for VOCs. The results of the 2004 usability assessment indicated no qualifications were applied to the results based on data completeness, preservation and technical holding times, GC/MS and GC/ECD instrument performance check, internal standards, laboratory control sample results, and sample quantitation and reported



quantitation limits. All associated organic data are usable for project decisions, with certain qualifications summarized below.

Approximately 0.07% of the positive landfill gas results were qualified as estimated (J) due to results detected at concentrations below the laboratory's reporting limit or not meeting RPD criteria. Approximately 0.06% of the non-detect landfill gas results were qualified as estimated (UJ) due to compounds not meeting continuing calibration criteria. Approximately 0.01% of the landfill gas results were qualified as undetected (U) due to blank contamination. None of the landfill gas results were rejected upon validation.

Overall the quantity and quality of the landfill gas data were of sufficient quality to meet the intended end use as described in the QAPP.

3.1.4 Leachate

The leachate data set is comprised of two leachate samples collected in April 2005. These samples were analyzed for VOCs, SVOCs, metals, PCBs, and pesticides. A Tier I level assessment of the data group indicated that no qualifications to the leachate data set were necessary.

3.2 EVALUATION OF PARCCS PARAMETERS

For the purposes of the Remedial Investigation, a data usability review was conducted on samples collected between October 2004 and November 2006. As part of this process, quality assurance indicators were utilized to evaluate sample collection and measurement error. These indicators have been examined in the context of the intended use of the data, and an overall assessment of the data for rendering decisions has been completed.

The precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS) parameter evaluation included an assessment of the parameters and QA/QC samples as they affect the usability of the site sample results. Qualifications applied to the QA/QC samples (e.g., trip blanks, equipment blanks, etc.) have been excluded from this discussion, but are detailed in the data validation summary reports provided in Appendix H. Data usability was evaluated according to the PARCCS parameters as presented on Table 7-2 through 7-9 of the QAPP and is summarized in the following sections.

3.2.1 Precision

Precision is a measure of mutual agreement between concentrations of samples collected at the same time from the same location. Precision is measured by performing duplicate measurements in the field or laboratory and is expressed in terms of Relative Percent Difference (RPD). Precision was evaluated quantitatively using field duplicates and laboratory duplicates. Analytical precision was also evaluated by comparing laboratory duplicate samples and the RPDs for MS/MSD analyses.

Comparison of primary sample results to field duplicate results was made to determine the RPD between concentrations detected in a primary sample and its associated duplicate sample. Laboratory duplicates and the %RPD for MS/MSD samples were also used to assess analytical precision. The majority of RPDs met acceptance criteria, indicating good sample homogeneity. The majority of the samples with the unacceptable RPDs were comprised of sediment and soil matrices which are typically less homogeneous than surface water and groundwater matrices. Details on the type and location of noncompliant results are provided on the data validation summaries in Appendix H.

Data precision was also evaluated qualitatively by comparison samples (generally groundwater and surface water samples) collected from individual monitoring points over time (refer to data summary tables provided in Section 5 of this report). This comparison indicates the data are generally consistent and/or decrease over time indicating the data are sufficiently precise over time.



3.2.2 Accuracy

Accuracy is a measure of agreement between results obtained from an analytical method compared with known values. The accuracy of laboratory analytical procedures is measured through a review of calibration, matrix spike, and laboratory control sample results.

Calibration results were reviewed to determine if samples results were accurately quantified. Two types of calibrations (initial and continuing) were included in the review. Initial calibrations were evaluated based on instrument responses to different concentrations of standards of the target compounds. Continuing calibration results were analyzed to provide a check of the accuracy of the analytical instrumentation. The initial and continuing calibration criteria were met for the majority of the samples, indicating the sample results were accurately quantified. Acrolein was the most common non-compliant result and was rejected (R qualified) in approximately 75% of the samples. Further details on the type and location of noncompliant results are provided on the data validation summaries in Appendix H.

Site-specific Matrix Spike/Matrix Spike Duplicate samples were spiked with known concentrations of analytes to determine potential interferences that may exist within the sample matrix. Matrix spike recoveries for all parameters and all media were within the recovery criteria specified in the QAPP, with the exceptions provided on the data validation summaries in Appendix H.

Laboratory control samples (LCS) were used to determine the accuracy of the analytical methods used to obtain samples concentrations. LCS consist of analyte-free media to which known concentrations of analytes are added. The reported concentrations are divided by the known concentrations to obtain the percent recoveries. Comparison of these percent recoveries against the recovery criteria specified in the QAPP indicate that all samples concentrations were accurately quantified.

3.2.3 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variation, or environmental condition. The overall representativeness of the data was evaluated qualitatively using site use information and historical sampling data and development and implementation of workplans to address data gaps. Based on continual evaluation of site information and data between 2004-2006, the data are concluded to be representative of subsurface conditions at the Site.

The spatial variability exhibited in the data set is consistent with the locations of site features, known source areas, and the geologic configuration of the Site. During the investigation activities, consistent procedures and laboratory analysis of the data were achieved, and data completeness goals were met for all media. Based on a review of established standard methods and procedures for collection and analysis of data, the data collected as part of the RI are considered to be of comparable quality over the entire sampling period. With respect to the sediment data set, for which a large percentage of the 2005-2006 data was rejected due to a low percentage of solids in the samples collected (i.e., sediment samples collected from the Deep Marsh area south of the Southern Lobe), review of the historic data from this area [SD-01(99) and SD-02(99)] confirm that the native materials are in fact comprised of a low percentage of solids.

Representativeness was also evaluated based on the results reported for trip blanks, equipment blanks, method blanks, and instrument blanks. Certain results were qualified accordingly based on the type and level of blank contamination. Representativeness of the data was also evaluated based on sample preservation and holding times, with very few sample results reported with noncompliant preservation and/or holding times. Exceptions are noted on the data validation summaries in Appendix H.



3.2.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount of valid data expected. The completeness goal for the project as required by the QAPP is 90%.

The data packages from Alpha Analytical Laboratories of Westborough, Massachusetts and their subconsultants Eno Rivers Labs, LLC of Durham, North Carolina (dioxins) were reviewed to ensure that all sample and associated quality assurance results were available. Samples collected in association with the Phase 1A, Phase 1B, and Pre-ROD workplans were analyzed in sample delivery groups (SDGs) as presented in Appendix I of this report. Results of the completeness review indicated that all collected samples were analyzed and all quality control results were available to complete data validation procedures for the required Tier level of validation.

With the exception of one soil sample, 100% of the samples submitted to the laboratory were analyzed in accordance with the Phase 1A, Phase 1B, and Pre-ROD workplans (variances from the project workplans are discussed in Section 2.2.1 of this report). Landfill soil sample SG-3 was accidentally discarded by the laboratory prior to analysis of grain size, soil strength, and moisture density. No other samples were discarded, broken, or otherwise destroyed prior to analysis.

The majority of samples collected during the RI investigation were determined to be usable data. As discussed previously, a percentage of soil/sediment data collected during the 2005 and 2006 investigations were rejected (R qualified) upon validation due to a low percentage of solids.

3.2.5 Comparability

Per the QAPP, comparability is a measure of the degree of confidence with which one data set can be compared to a related set of data. The objective for comparability is to ensure that the results of the analyses for this project can be compared with analyses by other laboratories. This objective has been attained by ensuring:

- Sampling and analytical procedures consistent with those used during previous investigations at the Site;
- Standards that are traceable to the National Institute of Standards and Technology or EPA sources;
- Standard methodologies;
- Consistent units for reporting results from similar matrices for comparison of previously collected data and for agreement within other organizations reporting similar data;
- Application of appropriate levels of QC within the context of the Laboratory Quality Assurance Programs; and
- Evaluation of results from inter-laboratory studies to document general laboratory performance.

3.2.6 Sensitivity

Sensitivity was evaluated based on a review of the sample quantitation and reported quantitation limits. The review indicates the criteria were met for all groundwater, surface water, soil, and sediment samples with the following exceptions. The positive acetone results for two sediment (WS-104 and WS-105) and four soil samples (SS-108, WS-109, SS-110, and WS-113) were qualified as estimated (J qualified) since the acetone results exceeded the upper calibration limit of the low level VOC analyses. The reported concentrations were not sufficiently high enough to be detected at the medium level analyses.



Sensitivity was also evaluated based on the laboratory control sample (laboratory fortified blank) results. No qualifications were made based on the LCS results, indicating acceptable sensitivity of the analytical methods.

Due to the low percentage of solids (less than or equal to 30%, but greater than or equal to 10%) in four soil samples (SB-10, WS-106, WS-109, and WS-113) and fourteen sediment samples (SD-38, WS-11, WS-101, WS-102, WS-103, WS-104, WS-105, SD-200, SD-201, SD-216, SD-217, SD-218, SD-219, and SD-221), positive results were estimated (J qualified) and non-detect results were rejected (R qualified). Similarly, professional judgment was used to qualify non-detect dioxin results as estimated (UJ qualified) in one soil sample (SS-5), due to the low percentage of solids.

In addition to the QAPP requirements, sensitivity was evaluated by comparing the reporting limits for non-detect compounds to the numerical Project Action Limits (PALs) established in Section 6.0 of the QAPP. As shown in these tables, the PALs for certain contaminants, particularly those based on ecological benchmarks, are below the established Project Quantitation Limit (PQL) and therefore current methods are not sensitive enough to meet the PAL (e.g., PCBs in soil as presented on Table 6-17). In general, non-detect results were reported at the PQLs. Non-detect results reported above the PQLs were most often attributed to sample dilutions required due to the presence of elevated concentrations of other contaminants in the samples (i.e., groundwater samples collected from the source areas) or matrix effects with the soil/sediment samples (due to low percentage solids content). To a lesser degree, reporting limits were also elevated due to actions associated with blanks, where a detected result was converted to a non-detect result at the reported concentration (e.g., zinc at WS-111).

3.2.7 RI Data Usability Summary

In summary, the RI sampling program is considered to be complete with more than 97.3 percent of the data deemed usable in the data quality assessment (both historically and newly collected). A review of the usability by media is provided below:

- 99.7% of the surface water data was deemed usable;
- 99.3% of sediment data was deemed usable (includes non-detected and rejected data collected from Deep Marsh in 2005 and 2006, refer to Section 3.1.1);
- 95.3% of soil data was deemed usable (includes non-detected and rejected data collected from Deep Marsh in 2005 and 2006, refer to Section 3.1.1);
- 98.0% of the groundwater data was deemed usable;
- 99.6% of the groundwater (temporary wells) data was deemed usable; and
- 100% of the landfill gas data was deemed usable.

It should be noted that a portion of the temporary well data (e.g., geoprobes) and leachate data were excluded from the usability calculation since they were validated at only the Tier I level.

Based on the data quality assessment, the PQOs have been achieved and thus the data collected as part of this RI is considered to be 'suitable' for its intended use in satisfying the RI objectives. These objectives (or end uses) include evaluating the contaminant sources; determining the nature, extent, and distribution of contaminants; and assessing the current and future potential risks to human health and the environment.

3.3 DATA PRESENTATION

This section presents the specific data by media (both previous investigations and newly collected RI data) for the laboratory data that was used in the RI/FS. Table 3-3 presents the specific historic data that has been included on these data tables. For each media, an analytical testing summary table has been



prepared and is presented as Table 3-4 through 3-11, which indicates the specific sample date and laboratory analyses for each sample. These tables are sorted by the RI data groupings as discussed in Section 5.0 and summarized below.

Group 1: Northern Landfill Lobe

Group 2: Southern Landfill Lobe

Group 3: Former Drum Disposal Area and Adjacent Disturbed Area

Group 4: Former Residence, Garage and Storage Area

Group 5: Sutton Brook and Associated Tributaries and Wetland Areas

Group 6: Area South of the Southern Lobe

Group 7: Reference Locations

Additionally, the laboratory data (see list below) is provided in Appendix I in electronic Excel “look-up” formats.

Soil (Table I-1)

Groundwater (Table I-2)

Groundwater Temporary Wells (Table I-3)

Surface Water (Table I-4)

Sediment (Table I-5)

Ambient air (Table I-6)

Landfill gas (Table I-7)

Physical Characteristics in Soil and Sediment (Table I-8)

Leachate (Table I-9)

These tables include the parameters analyzed for each sample location, including laboratory detection limits, data validation codes, and tentatively identified compounds. Given the size of the data set, these tables have been provided in electronic format only. Further summary tables by specific area of the site are presented (in hard copy) in Section 5 of this report.

Table 3-2

**Summary of Tentatively Identified Compounds Screening Evaluation
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Tentatively Identified Compounds Reported by Laboratory	Total Number of Primary Samples with Constituent Detected	Detected Range of Constituent (ug/l)	Retained as TIC	Rationale
Groundwater				
Volatile Organic Compounds (8260B)				
1-Pentene, 2-methyl-	1	0.08	No	TIC screened out as it represents less than 5% of data set
2-Heptanone, 4,6-dimethyl	1	15	No	TIC screened out as it represents less than 5% of data set
2-Propanol, 2-methyl-	8	1.9 - 76	No	Specific health based screening criteria does not exist
4-Heptanone, 2,6-dimethyl-	3	1.7 - 53	No	TIC screened out as it represents less than 5% of data set
Dichlorotetrafluoroethane	1	1	No	TIC screened out as it represents less than 5% of data set
Disiloxane, hexamethyl-	1	1.2	No	TIC screened out as it represents less than 5% of data set
Disulfide, diethyl	2	140 and 200	No	TIC screened out as it represents less than 5% of data set
Ethane, (methylthio)-	1	190	No	TIC screened out as it represents less than 5% of data set
Ethane, 1,1,2,2-tetrafluoro	2	6.4 and 8.1	No	TIC screened out as it is listed as a target analyte on the 8260 list
Ethane, 1,1,2-trichloro-1,2	1	6.7	No	TIC screened out as it represents less than 5% of data set
Ethane, 1,2-dichloro-1,1,2-	6	2.0 - 4.7	No	TIC screened out as it represents less than 5% of data set
Ethane, 1,2-dichloro-1,1,2-trifluoro	1	3.5	No	TIC screened out as it represents less than 5% of data set
Ethane, methoxy-	4	1.8 - 10	No	TIC screened out as it represents less than 5% of data set
Fluorodichloromethane	3	2.3 - 32	No	TIC screened out as it represents less than 5% of data set
Indane	4	1.7 - 4.8	No	TIC screened out as it represents less than 5% of data set
Isopropyl Alcohol	4	0.52 - 8100	No	TIC screened out as it represents less than 5% of data set
Methane, chlorodifluoro-	6	5 - 23	No	TIC screened out as it represents less than 5% of data set
Methane, chlorofluoro-	49	1 - 920	No	Specific health based screening criteria does not exist
Methane, dichlorofluoro-	31	1 - 2800	No	Specific health based screening criteria does not exist
Propene	4	1.5 - 200	No	TIC screened out as it represents less than 5% of data set
Silane, fluorotrimethyl-	4	1.1 - 14	No	TIC screened out as it represents less than 5% of data set
Silanol, trimethyl-	2	3.2 and 13	No	TIC screened out as it represents less than 5% of data set
Sulfur Dioxide	2	4.6 and 5.6	No	TIC screened out as it represents less than 5% of data set
Unknown ⁽¹⁾	189	0.21 - 91000	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown Alcohol	6	13 - 19000	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C6H14O Isomer	2	110 and 20000	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C9H10	2	1.5 and 21	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C9H10 Isomer	5	1.4 - 22	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C9H18O	1	46	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C9H18O Isomer	2	1 and 12	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown Ketone	1	3.7	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown Substituted Alkane	6	2.8 - 520	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown Substituted Benzene ⁽¹⁾	47	0.71 - 3200	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown Substituted Ketone	1	54	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification

Table 3-2

**Summary of Tentatively Identified Compounds Screening Evaluation
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Tentatively Identified Compounds Reported by Laboratory	Total Number of Primary Samples with Constituent Detected	Detected Range of Constituent (ug/l)	Retained as TIC	Rationale
Semi-Volatile Organic Compounds (8270C)				
1(3H)-Isobezofuranone	1	26	No	TIC screened out as it represents less than 5% of data set
1,3,5-Triazine-2,4,6(1H,3H,5H)-trione,	1	11	No	TIC screened out as it represents less than 5% of data set
1-(2-Methoxy-1-methylethyl)	3	53 - 62	No	TIC screened out as it represents less than 5% of data set
1,4-Dioxane	10	4.2 - 72	No	TIC screened out as it is listed as a target analyte on the 8260-SIM compound list and reported as a TIC in the 8270C list
2(3H)-Benzothiazolone	22	4.5 - 140	No	Specific health based screening criteria does not exist
2H-Indol-2-one, 1,3-dihydro	1	110	No	TIC screened out as it represents less than 5% of data set
2-Propanol, 1-(2-(2-methoxy-	3	33 - 76	No	TIC screened out as it represents less than 5% of data set
2-Propanol, 1-(2-(2-methoxy-1-methyleth	2	24 and 140	No	TIC screened out as it represents less than 5% of data set
2-Propanol, 1-(2-methoxy-1-methylethoxy	2	63 and 780	No	TIC screened out as it represents less than 5% of data set
2-Pyrrolidinone, 1-methyl-	1	1200	No	TIC screened out as it represents less than 5% of data set
4-Methylformanilide	1	6.8	No	TIC screened out as it represents less than 5% of data set
7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6	1	4.3	No	TIC screened out as it represents less than 5% of data set
7-Heptadecene, 1-chloro-	1	4.8	No	TIC screened out as it represents less than 5% of data set
Acetic acid, (2,4-xylyl)-	2	6.8 and 8.4	No	TIC screened out as it represents less than 5% of data set
Benzene, 1,2,3-trimethyl-	2	9.9 and 250	No	TIC screened out as it represents less than 5% of data set
Benzene, 1,2,4-trimethyl-	2	36 and 280	No	TIC screened out as it represents less than 5% of data set
Benzene, 1,3,5-trimethyl-	2	7.4 and 1500	No	TIC screened out as it represents less than 5% of data set
Benzene, 1,3-dimethyl-	1	120	No	TIC screened out as it represents less than 5% of data set
Benzene, 1-ethyl-2-methyl-	1	200	No	TIC screened out as it represents less than 5% of data set
Benzene, 1-ethyl-3-methyl-	2	20 and 2100	No	TIC screened out as it represents less than 5% of data set
Benzene, propyl-	1	61	No	TIC screened out as it represents less than 5% of data set
Benzeneacetic acid	4	160 - 5800	No	Specific health based screening criteria does not exist
Benzenepropanoic acid	2	1300 and 27,000	No	TIC screened out as it represents less than 5% of data set
Benzenepropanoic acid, .alp	1	30	No	TIC screened out as it represents less than 5% of data set
Benzenesulfonamide, N-ethyl	6	7.4 - 38	No	Specific health based screening criteria does not exist
Benzenesulfonamide, N-ethyl-2-methyl-	3	11 - 51	No	TIC screened out as it represents less than 5% of data set
Benzenesulfonamide, N-ethyl-4-methyl-	5	5.3 - 16	No	Specific health based screening criteria does not exist
Benzoic Acid	1	1600	No	TIC screened out as it represents less than 5% of data set
Benzoic acid, 2-methyl-	2	35 and 480	No	TIC screened out as it represents less than 5% of data set
Benzoic acid, 3-methyl-	1	780	No	TIC screened out as it represents less than 5% of data set
Benzoic acid, 4-methyl-	1	490	No	TIC screened out as it represents less than 5% of data set
Benzoic acid, p-tert-butyl-	5	9.3 - 23	No	Specific health based screening criteria does not exist
Benzylmalonic acid	3	39 - 18000	No	TIC screened out as it represents less than 5% of data set
Bicyclo(2.2.1)heptan-2-one,	1	24	No	TIC screened out as it represents less than 5% of data set
Bicyclo(2.2.1)heptan-2-one, 1,7,7-trime	1	80	No	TIC screened out as it represents less than 5% of data set
Bicyclo(3.1.1)heptan-2-one, 6,6-dimethy	1	10	No	TIC screened out as it represents less than 5% of data set
Butanonic Acid	1	2300	No	TIC screened out as it represents less than 5% of data set
C7H5NOS Unknown	1	130	No	TIC screened out as it represents less than 5% of data set
C8H8O2 Isomer	4	100 - 440	No	TIC screened out as it is an individual component in a complex mixture
C8H10 Isomer	6	99 - 2700	No	TIC screened out as it is an individual component in a complex mixture
C8H13O3 Isomer	1	1300	No	TIC screened out as it represents less than 5% of data set and it is an individual component in a complex mixture
C9H9NO Unknown	1	80	No	TIC screened out as it represents less than 5% of data set
C9H10O2 Isomer	1	100	No	TIC screened out as it represents less than 5% of data set and it is an individual component in a complex mixture
C9H10O2 Unknown	1	66	No	TIC screened out as it represents less than 5% of data set

Table 3-2

**Summary of Tentatively Identified Compounds Screening Evaluation
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Tentatively Identified Compounds Reported by Laboratory	Total Number of Primary Samples with Constituent Detected	Detected Range of Constituent (ug/l)	Retained as TIC	Rationale
C9H12 Isomer	11	11 - 1200	No	TIC screened out as it is an individual component in a complex mixture
C10H16O Isomer	2	68 and 100	No	TIC screened out as it represents less than 5% of data set and it is an individual component in a complex mixture
C11H14O2 Isomer	1	10	No	TIC screened out as it represents less than 5% of data set and it is an individual component in a complex mixture
C13H12O2	2	37 and 53	No	TIC screened out as it represents less than 5% of data set and it is an individual component in a complex mixture
Cyclic octaatomic sulfur	2	9 and 22	No	TIC screened out as it represents less than 5% of data set
Cyclohexanecarboxylic acid	2	1700 and 4500	No	TIC screened out as it represents less than 5% of data set
Cyclohexanone, 3,3,5-trimeth	2	1.2 and 47	No	TIC screened out as it represents less than 5% of data set
Diethyl disulfide	1	97	No	TIC screened out as it represents less than 5% of data set
Diethyltoluamide	11	13 - 150	No	Specific health based screening criteria does not exist
Ethanol, 2-butoxy-	1	2000	No	TIC screened out as it represents less than 5% of data set
Ethanol, 2-butoxy-, phosphate (3:1)	1	4.7	No	TIC screened out as it represents less than 5% of data set
Ethylbenzene	7	4.6 - 2000	No	TIC screened out as it is listed as a target analyte on the 8260 compound list and reported as a TIC on the 8270C list
Formamide, N,N-dimethyl-	20	61 - 19000	YES	EPA Region 9 PRG (3600 ug/l) exists for compound
Heptanoic acid	4	5200 - 30000	No	Specific health based screening criteria does not exist
Hexalene Glycol	1	92	No	TIC screened out as it represents less than 5% of data set
Hexanoic acid, 2-ethyl-	5	9000 - 32000	No	Specific health based screening criteria does not exist
Indane	1	55	No	TIC screened out as it represents less than 5% of data set
Methyl Isobutyl Ketone	8	60 - 18000	No	TIC screened out as it is listed as a target analyte on the 8260 compound list and reported as a TIC on the 8270C list
m-Xylene	1	3700	No	TIC screened out as it is listed as a target analyte on the 8260 compound list and reported as a TIC on the 8270C list
Naphthalene, 1,2,3,4,4a,5,6,8a-octahydr	1	15	No	TIC screened out as it represents less than 5% of data set
Naphthalene, decahydro-4a-methyl-1-meth	1	8.9	No	TIC screened out as it represents less than 5% of data set
n-Decanoic acid	1	2400	No	TIC screened out as it represents less than 5% of data set
Nonanoic acid	2	720 and 3400	No	TIC screened out as it represents less than 5% of data set
Octadecanoic acid	1	5	No	TIC screened out as it represents less than 5% of data set
Octanoic Acid	4	4400 - 37000	No	Specific health based screening criteria does not exist
o-Xylene	9	2.5 - 4900	No	TIC screened out as it is listed as a target analyte on the 8260 compound list and reported as a TIC on the 8270C list
Pentobarbital	2	4.1 and 11	No	TIC screened out as it represents less than 5% of data set
Phenol, 2-((4-hydroxyphenyl)methyl)-	1	62 and 63	No	TIC screened out as it represents less than 5% of data set
Phenol, 2,3,5-tribromo-	1	67 and 74	No	TIC screened out as it represents less than 5% of data set
Phenol, 2-ethyl-	1	65	No	TIC screened out as it represents less than 5% of data set
Phenol, 3-propyl-	1	42	No	TIC screened out as it represents less than 5% of data set
Phenol, 4,4'-(1-methylethyl)	3	12 - 82	No	TIC screened out as it represents less than 5% of data set
Phenol, 4,4'-(1-methylethylidene)bis-	1	5.9 - 96	No	TIC screened out as it represents less than 5% of data set
Phenol, 4-ethyl-	1	43	No	TIC screened out as it represents less than 5% of data set
Phenol, p-tert-butyl-	1	17	No	TIC screened out as it represents less than 5% of data set
Propanedioic acid, phenyl-	2	140 and 4300	No	TIC screened out as it represents less than 5% of data set
p/m-Xylene	1	26	No	TIC screened out as it is listed as a target analyte on the 8260 compound list and reported as a TIC on the 8270C list
p-Xylene	7	7.6 - 3400	No	TIC screened out as it is listed as a target analyte on the 8260 compound list and reported as a TIC on the 8270C list
Pyrimidin-4(3H)-one, 2-(4-nitrobenzylth	1	7.5	No	TIC screened out as it represents less than 5% of data set

Table 3-2

**Summary of Tentatively Identified Compounds Screening Evaluation
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Tentatively Identified Compounds Reported by Laboratory	Total Number of Primary Samples with Constituent Detected	Detected Range of Constituent (ug/l)	Retained as TIC	Rationale
Toluene	7	4.2 - 8100	No	TIC screened out as it is listed as a target analyte on the 8260 compound list and reported as a TIC on the 8270C list
Tri(2-chloroethyl) phosphate	2	26 and 120	No	TIC screened out as it represents less than 5% of data set
Triethyl phosphate	1	32	No	TIC screened out as it represents less than 5% of data set
Tridecanoic acid	1	15	No	TIC screened out as it represents less than 5% of data set
Unknown C2H2CL4	2	26 and 35	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C4H8O2NO	1	29	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C5H9NO	1	1000	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C6H12O	3	730 - 24000	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C6H14O	3	73 - 22000	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C7H5NOS	1	65	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C8H7NO	1	54	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C8H16O2	2	9300 and 51000	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C8H18O2	1	290	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C9H13NO2S	2	14 and 22	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C10H16O	3	28 - 110	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C10H20O2	1	20	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C12H17NO	1	17	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C30H56O6	1	10	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown Organic	1	2500	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown Organic Acid	32	16 - 51000	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown Substituted Benzoic	1	22	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Surface Water				
Volatile Organic Compounds (8260B)				
Acetaldehyde	1	2.4	No	TIC screened out as it represents less than 5% of data set
Dimethyl sulfide	1	2.8	No	TIC screened out as it represents less than 5% of data set
Fluorodichloromethane	1	1.6	No	TIC screened out as it represents less than 5% of data set
Indane	1	1.9	No	TIC screened out as it represents less than 5% of data set
Methane, chlorofluoro-	12	1.3 - 7.4	No	Specific health based screening criteria does not exist
Methane, dichlorofluoro-	2	1.6 and 2.5	No	TIC screened out as it is listed as a target analyte on the 8260 list

Table 3-2

**Summary of Tentatively Identified Compounds Screening Evaluation
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Tentatively Identified Compounds Reported by Laboratory	Total Number of Primary Samples with Constituent Detected	Detected Range of Constituent (ug/l)	Retained as TIC	Rationale
Sulfur Dioxide	2	4.6 and 4.9	No	Specific health based screening criteria does not exist and the presence of sulfur dioxide does not appear to be related to site contaminants ⁽²⁾ .
Unknown	7	1.5 - 6.2	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown Alcohol	1	1.9	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C6H12O Isomer	1	0.75	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown Substituted Alkane	5	1.4 - 16	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown Substituted Benzene	6	1.1 - 11	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Semi-Volatile Organic Compounds (8270C)				
2(3H)-Benzothiazolone	4	3.9 - 7.3	No	Specific health based screening criteria does not exist
2,4-Dimethyl-1-heptene	2	9.1 and 9.7	No	Specific health based screening criteria does not exist
Ethane, 1,1,2,2-tetrachloro	4	22 - 410	No	TIC screened out as it is listed as a target analyte on the 8260 list
Hexanoic acid, 2-ethyl-	1	4.6	No	TIC screened out as it represents less than 5% of data set
Methyl Isobutyl Ketone	2	6.3 and 8.9	No	TIC screened out as it is listed as a target analyte on the 8260 compound list and reported as a TIC on the 8270C list
n-Hexadecanoic acid	1	6.6	No	Identified as TIC in reference location and it represents less than 5% of data set
Octadecanoic acid	4	4.4 - 11	No	Identified as TIC in reference location
p-Xylene	3	3.9 - 7.8	No	TIC screened out as it is listed as a target analyte on the 8260 compound list and reported as a TIC on the 8270C list
Unknown	8	3.9 - 1400	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
Unknown C14H22 Isomer	1	7.3	No	All TICs labeled as unknown are screened out because no evaluation is possible without tentative identification
<p>Notes:</p> <p>(1) = Includes TICs reported in both VOC and SVOC analyses.</p> <p>(2) = No groundwater TICs were identified in QC (trip or field blanks) samples collected with the exception of the trip blank associated with the November 2006 surface water sampling event. The laboratory suspects the presence of sulfur dioxide may be attributed to Sulfur dioxide was identified as a TIC in the trip blank, each of the primary samples, and in the method blank.</p> <p>For groundwater VOCs and SVOCs, only background or reference samples collected, with the exception of Unknown TICs and sulfur dioxide in certain background samples.</p> <p>From 2004-2006, a total of 165 groundwater sampling locations were collected for VOC analysis (8 or more samples represents ≥5% of data set).</p> <p>From 2004-2006, a total of 77 groundwater sampling locations were collected for SVOC analysis (4 or more samples represents ≥5% of data set).</p> <p>From 2004-2006, a total of 33 surface water sampling locations were collected for VOC analysis (2 or more samples represents ≥5% of data set).</p> <p>From 2004-2006, a total of 20 surface water sampling locations were collected for SVOC analysis (2 or more samples represents ≥5% of dataset).</p> <p>ug/l = micrograms per liter</p> <p>TIC = Tentatively Identified Compound</p> <p>Health Based Criteria = MCLs, MA MCP standards, Region 3 RBCs, and Region 9 PRGs</p>				

Table 3-3

**Summary of Historic Data Quantitatively Presented on Data Tables
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site – Tewksbury, Massachusetts**

Report	Description	Included in Data Tables
November 1989, NUS Corporation, Trip Report On site Reconnaissance, Soil/sediment and Leachate Sampling;	October 1989 – 11 soil samples and 3 sediment samples	Yes
September 1992, EPA, Ambient Air Survey Results	August 1992 – 7 ambient air samples	Yes
June 1996, MADEP, Rocco Landfill Initial Site Assessment (M&E)	June - Oct 1995 – 3 landfill gas samples; groundwater samples from 10 monitoring wells; 3 sediment samples; and 3 surface water samples	Yes
February 2000, MADEP, Preliminary Data Report, Rocco Landfill Investigation (IT Corporation)	June – Jul 1999 - groundwater samples from 26 monitoring wells; and 4 surface water samples	Yes
March 2000, EPA, Final Summary Trip Report (Weston)	Aug – Sep 1999 – groundwater samples from 20 monitoring wells; 6 wetland soil samples; 26 upland soil samples; 23 sediment samples; and 9 surface water samples	Yes
February 2001, EPA, Removal Program Preliminary Assessment/Site Investigation report 19 Bemis Circle (Weston)	Sept – Oct 2000 – 12 soil samples	Yes
September 2001, EPA, Data Evaluation Technical Memorandum Final (M&E)	Mar 2001 – groundwater samples from 22 monitoring wells	Yes
March 2002, EPA Removal Program After Action Report (Weston)	Jul – Nov 2000 – 14 post-excavation soil samples	No; laboratory data sheets not provided, only summary tables of select compounds provided. Data discussed in Section 7.
2002, USGS, Distribution of VOCs in Sediments near Sutton Brook Disposal Area	May 2001 – 143 passive vapor diffusion samplers in brook and 7 surface water samples	No; data not quantified.
August 2002, Higgins Environmental Associates, Downgradient Property Status Opinion Perkins Development Trust	April and June 2002 – 7 soil samples and 7 groundwater samples.	Yes

Table 3-4

Analytical Testing Summary - Soil Samples
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Group	Location Descriptor	VOC	PAHs	SVOC	Metals	Cyanide	PCBs	Pesticides	TPH	EPH w/PAH	VPH w/VOC	TOC	pH	Dioxins	Soil Strength	Grain Size	Moisture Density
SS-02 (89)	10/26/89	0 - 0.67	1	Upland	X		X	X		X	X									
SS-03 (89)	10/26/89	0 - 0.67	1	Upland	X		X	X		X	X									
SS-04 (89)	10/26/89	0 - 0.67	1	Upland	X		X	X		X	X									
SS-05 (89)	10/26/89	0 - 0.83	1	Upland	X		X	X		X	X									
SS-08 (89)	10/26/89	0 - 0.67	1	Upland	X		X	X		X	X									
SS-09 (89)	10/26/89	0 - 0.17	1	Upland	X		X	X		X	X									
SS-10 (89)	10/26/89	0 - 0.33	1	Upland	X		X	X		X	X									
SD-03 (99)	08/09/99	0 - 0.5	1	Wetland	X		X	X	X	X	X									
SD-04 (99)	08/09/99	0 - 0.5	1	Wetland	X		X	X	X	X	X									
PMW-1 (02)	04/11/02	4 - 6	1	Upland		X		X		X	X	X								
		6 - 8			X	X		X		X	X	X								
PMW-2 (02)	04/11/02	7 - 9	1	Upland	X	X		X		X	X	X								
PMW-3 (02)	04/11/02	6 - 8	1	Upland	X	X		X		X	X	X								
SG-1 (04)	10/28/04	0 - 1.5	1	Upland														X	X	X
SG-2 (04)	10/28/04	0 - 1.5	1	Upland														X	X	X
GP-1 (04)	11/08/04	0 - 1	1	Wetland	X		X	X		X	X				X	X				
Total Number of Group 1 Samples					13	4	10	14	2	14	14	4	0	0	1	1	0	2	2	2
SS-06 (89)	10/26/89	0 - 0.42	2	Upland	X		X	X		X	X									
SS-07 (89)	10/26/89	0 - 1.5	2	Upland	X		X	X		X	X									
WED-05 (99)	08/19/99	10 - 12	2	Upland	X		X	X	X	X	X									
SG-4 (04)	10/28/04	0 - 1.5	2	Upland														X	X	X
SG-5 (04)	10/28/04	0 - 1.5	2	Upland														X	X	X
SS-8 (04)	11/08/04	0 - 1	2	Upland	X		X	X		X	X				X	X	X			
Total Number of Group 2 Samples					4	0	4	4	1	4	4	0	0	0	1	1	1	2	2	2
SB-1 (04)	10/05/04	4 - 5	3	Upland	X		X													
		5 - 6						X		X	X									
SB-2 (04)	10/08/04	6 - 8	3	Upland						X	X									
		8 - 10			X		X													
		10 - 12						X												
SB-3 (04)	10/08/04	0 - 2	3	Upland	X		X													
		4 - 6						X		X	X									
SB-4 (04)	10/06/04	5 - 7	3	Upland	X		X													
		7 - 8						X		X	X									
SB-5 (04)	10/08/04	2 - 4	3	Upland			X	X		X	X									
		4 - 6			X															
SB-6 (04)	10/06/04	4 - 5	3	Upland	X		X													
		5 - 7						X		X	X									
GP-23 (04)	11/09/04	0 - 1	3	Wetland	X		X	X		X	X				X	X				
SS-13 (04)	11/08/04	0 - 1	3	Wetland	X		X	X		X	X				X	X				
SS-14 (04)	11/09/04	0 - 1	3	Wetland	X		X	X		X	X				X	X				

Table 3-4

Analytical Testing Summary - Soil Samples
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Group	Location Descriptor	VOC	PAHs	SVOC	Metals	Cyanide	PCBs	Pesticides	TPH	EPH w/PAH	VPH w/VOC	TOC	pH	Dioxins	Soil Strength	Grain Size	Moisture Density	
Total Number of Group 3 Samples					9	0	9	9	0	9	9	0	0	0	3	3	0	0	0	0	
SO-01 (99)	08/04/99	0 - 0.5	4	Upland	X		X	X	X	X	X		X	X							
SO-02 (99)	08/04/99	0 - 0.5	4	Upland	X		X	X	X	X	X		X	X							
SO-04 (99)	08/04/99	0 - 0.5	4	Upland	X		X	X	X	X	X		X	X							
SO-05 (99)	08/04/99	0 - 0.5	4	Upland	X		X	X	X	X	X		X	X							
SO-06 (99)	08/04/99	0 - 0.5	4	Upland	X		X	X	X	X	X		X	X							
SO-07 (99)	08/04/99	0 - 0.5	4	Upland	X		X	X	X	X	X		X	X							
SO-08 (99)	08/04/99	0 - 0.5	4	Upland	X		X	X	X	X	X		X	X							
SO-09 (99)	08/04/99	0 - 0.5	4	Upland	X		X	X	X	X	X		X	X							
SO-10 (99)	08/04/99	0 - 0.5	4	Upland	X		X	X	X	X	X		X	X							
WED- 07 (99)	08/18/99	15 - 17	4	Upland	X		X	X	X	X	X										
SB-7 (04)	10/05/04	0.5 - 1.0	4	Upland				X													
		1.5 - 2.0			X																
		2.0 - 2.5					X			X	X										
SB-8 (04)	10/04/04	2.5	4	Upland	X																
		2.0 - 2.5					X			X	X										
		2.5 - 3.0						X													
SB-9 (04)	10/04/04	2.8	4	Upland	X																
		2.5 - 3.5					X	X		X	X										
SB-10 (04)	10/04/04	1.5 - 2.0	4	Upland				X													
		4.0 - 5.0					X			X	X										
		7.5			X																
Total Number of Group 4 Samples					14	0	14	14	10	14	14	0	9	9	0	0	0	0	0	0	
SD-12 (99)	08/10/99	0 - 0.5	5	Wetland	X		X	X	X	X	X										
SD-13 (99)	08/10/99	0 - 0.5	5	Wetland				X													
GP-7 (04)	11/09/04	0 - 1	5	Wetland	X		X	X		X	X				X	X					
GP-8 (04)	11/08/04	0 - 1	5	Wetland	X		X	X		X	X				X	X					
SS-5 (04)	11/18/04	0 - 2	5	Wetland	X		X	X		X	X				X	X	X				
WS-6 (04)	11/08/04	0 - 1	5	Wetland	X		X	X		X	X				X	X					
SS-9 (04)	11/09/04	0 - 1	5	Wetland	X		X	X		X	X				X	X	X				
WS-106 (05)	11/29/05	0 - 1	5	Wetland				X													
WS-107 (05)	11/29/05	0 - 1	5	Wetland				X													
Total Number of Group 5 Samples					6	0	6	9	1	6	6	0	0	0	5	5	2	0	0	0	
SS-13 (89)	10/26/89	0 - 1.5	7	R-Upland	X		X	X		X	X										
SS-12 (89)	10/26/89	0 - 0.67	7	R-Upland	X		X	X		X	X										
SS-01 (99)	08/04/99	0 - 0.5	7	R-Upland	X		X	X	X	X	X										
SS-02 (99)	08/04/99	0 - 0.5	7	R-Upland				X													
SS-03 (99)	08/04/99	0 - 0.5	7	R-Upland	X		X	X	X	X	X										
SS-05 (99)	08/04/99	0.5 - 2	7	R-Upland	X		X	X	X	X	X										
SS-08 (99)	08/04/99	0 - 0.5	7	R-Upland	X		X	X	X	X	X										

Table 3-4

Analytical Testing Summary - Soil Samples
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Group	Location Descriptor	VOC	PAHs	SVOC	Metals	Cyanide	PCBs	Pesticides	TPH	EPH w/PAH	VPH w/VOC	TOC	pH	Dioxins	Soil Strength	Grain Size	Moisture Density
SS-09 (99)	08/04/99	0.5 - 2	7	R-Upland	X		X	X	X	X	X									
SS-10 (99)	08/04/99	0.5 - 2	7	R-Upland	X		X	X	X	X	X									
SS-11 (99)	08/04/99	0 - 0.5	7	R-Upland	X		X	X	X	X	X									
SS-12 (99)	08/04/99	0 - 0.5	7	R-Upland	X		X	X	X	X	X									
SS-13 (99)	08/04/99	0 - 0.5	7	R-Upland	X		X	X	X	X	X									
SS-14 (99)	08/04/99	0 - 0.5	7	R-Upland	X		X	X	X	X	X									
SS-15 (99)	08/04/99	0.5 - 2	7	R-Upland	X		X	X	X	X	X									
SS-16 (99)	08/04/99	0 - 0.5	7	R-Upland	X		X	X	X	X	X									
SS-17 (99)	08/04/99	1.5 - 2	7	R-Upland	X		X	X	X	X	X									
SD-08 (99)	08/10/99	0 - 0.5	7	R-Wetland	X		X	X	X	X	X									
SD-09 (99)	08/10/99	0 - 0.5	7	R-Wetland				X												
WED-02 (99)	08/19/99	15 - 17	7	R-Upland	X		X	X	X	X	X									
SS-01 (00)	09/27/00	0 - 6	7	R-Upland	X		X	X	X	X	X									
SS-02 (00)	09/27/00	6 - 12	7	R-Upland	X		X	X	X	X	X									
SS-03 (00)	09/27/00	4 - 8	7	R-Upland	X		X	X	X	X	X									
SS-04 (00)	09/27/00	4 - 8	7	R-Upland	X		X	X	X	X	X									
SS-05 (00)	09/27/00	1.5 - 2	7	R-Upland	X		X	X	X	X	X									
SS-06 (00)	09/27/00	1.5 - 2	7	R-Upland	X		X	X	X	X	X									
SS-07 (00)	09/27/00	1.5 - 2	7	R-Upland	X		X	X	X	X	X									
SS-08 (00)	10/25/00	0 - 0.25	7	R-Upland	X		X	X	X	X	X									
SS-09 (00)	10/25/00	0 - 0.25	7	R-Upland	X		X	X	X	X	X									
SS-10 (00)	10/25/00	0 - 0.25	7	R-Upland	X		X	X	X	X	X									
SS-11 (00)	10/25/00	0 - 0.25	7	R-Upland	X		X	X	X	X	X									
SS-12 (00)	10/25/00	0 - 0.25	7	R-Upland	X		X	X	X	X	X									
PMW-4 (02)	05/28/02	0 - 2	7	R-Upland				X ¹												
PMW-5 (02)	05/28/02	0 - 2	7	R-Upland				X ¹												
PMW-6 (02)	05/28/02	2 - 4	7	R-Upland				X ¹												
SS-3 (04)	11/08/04	0 - 1	7	R-Upland	X		X	X		X	X				X	X				
WS-4 (04)	11/08/04	0 - 1	7	R-Wetland	X		X	X		X	X				X	X				
SS-1 (04)	11/23/04	0 - 1	7	R-Upland	X		X	X		X	X				X	X	X			
SS-2 (04)	11/23/04	0 - 1	7	R-Upland	X		X	X		X	X				X	X				
WS-112 (05)	11/29/05	0 - 1	7	R-Wetland	X		X	X		X	X				X	X				
WS-113 (05)	11/29/05	0 - 1	7	R-Wetland	X		X	X		X	X				X	X				
SS-110 (05)	11/29/05	0 - 1	7	R-Upland	X		X	X		X	X				X	X				
SS-108 (05)	12/01/05	0 - 1	7	R-Upland	X		X	X		X	X				X	X				
WS-109 (05)	12/01/05	0 - 1	7	R-Wetland	X		X	X		X	X				X	X				
WS-111 (05)	12/01/05	0 - 1	7	R-Wetland	X		X	X		X	X				X	X				
Total Number of Group 7 Samples					39	0	39	44	27	39	39	0	0	0	10	10	1	0	0	0
Total Number of Samples					85	4	82	94	41	86	86	4	9	9	20	20	4	4	4	4

Table 3-4

Analytical Testing Summary - Soil Samples
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Group	Location Descriptor	VOC	PAHs	SVOC	Metals	Cyanide	PCBs	Pesticides	TPH	EPH w/PAH	VPH w/VOC	TOC	pH	Dioxins	Soil Strength	Grain Size	Moisture Density
<p>NOTE:</p> <p>X = The sample was submitted for the analysis indicated.</p> <p>X¹ = The sample was submitted for arsenic and thallium analysis only.</p> <p>A blank space indicates the sample was not analyzed for this constituent.</p> <p>ft = feet below ground surface</p> <p>VOC = Volatile organic compounds by CLP Volatile Organic Analysis (1989), EPA Method 8260B (1999, 2000, 2002, 2004, and 2005).</p> <p>PAH = Polynuclear aromatic hydrocarbons.</p> <p>SVOC = Semi-volatile organic compounds by CLP Extractable Organic Analysis (1989), EPA Method 8270C (1999, 2000, 2002, 2004, and 2005).</p> <p>Metals by CLP Inorganic Analysis (1989), EPA 6000/7000 Series Methods (1999, 2000, 2002, 2004, and 2005).</p> <p>PCB = Polychlorinated biphenyls by CLP Extractable Organic Analysis (1989), EPA Method 8082 (1999, 2000, 2002, 2004, and 2005).</p> <p>Pesticides by CLP Extractable Organic Analysis (1989) EPA Method 8081/8081A (1999, 2000, 2002, 2004, and 2005).</p> <p>TPH = Total petroleum hydrocarbons by a Modified EPA Method 8100 (2002).</p> <p>EPH = Extractable petroleum hydrocarbons (MADEP Method 1998).</p> <p>VPH = Volatile petroleum hydrocarbons (MADEP Method 1998).</p> <p>TOC = Total organic carbon by Lloyd Kahn (2004 and 2005).</p> <p>pH - by EPA Method 9045C.</p> <p>Dioxins - by EPA Method 8280A (2004).</p> <p>Soil Strength by direct shear ASTM D-3080.</p> <p>Grain Size by Sieve ASTM C-117 and C-136.</p> <p>Moisture Density by Standard Proctor ASTM D-698.</p> <p>R-Upland = Reference Upland</p> <p>R-Wetland = Reference Wetland</p>																				

Table 3-5

**Analytical Testing Summary - Groundwater Monitoring Wells
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Sample Location Identifier	Sample Date	Screened Interval (ft)	Group	VOC	1,4-Dioxane	PAH	SVOC	Metals		Cyanide	PCB	Pesticides	TPH	EPH	VPH	General Chemistry	MNA
								Total	Dissolved								
MW-2S	06/28/95	5 - 15	1	X			X	X		X	X					X	
	07/02/99			X			X	X									
	11/16/04			X	X		X	X									
MW-2B	06/28/95	23 - 37	1	X			X	X		X	X					X	
	07/07/99			X			X	X									
	11/16/04			X	X		X	X									
MW-3S	06/29/95	9 - 19	1				X	X		X	X					X	
	10/30/95			X													
	07/07/99			X			X	X									
	09/16/99			X			X	X		X	X	X					
	11/16/04			X	X		X	X									
	09/21/05			X	X			X									
	12/19/05			X	X			X									
	02/14/06			X	X			X									
	06/06/06			X	X			X									
	10/04/06			X	X			X									
	MW-3B			06/29/95	38 - 51.5	1	X			X	X		X	X			
07/07/99		X					X	X									
09/16/99		X					X	X		X	X	X					
11/16/04		X	X				X	X									
09/21/05		X	X					X									
12/19/05		X	X					X									
02/15/06		X	X					X									
06/06/06		X	X					X									
10/04/06		X	X					X									
MW-6	06/28/95	5 - 15	1	X			X	X		X	X					X	
	07/07/99			X			X	X									
	11/16/04			X	X		X	X	X								
MW-12	06/28/99	4 - 14	1	X			X	X									
	11/16/04			X	X		X	X									
	10/05/06																X ⁴
PMW-1	04/18/02	4 - 14	1	X		X		X			X	X	X				
	06/04/02			X				X			X	X	X				
	11/22/04			X	X		X	X									X04
	06/07/06			X	X												X06
PMW-2	04/18/02	4 - 14	1	X		X		X			X	X	X				
	12/08/04						X	X	X								
	01/05/05			X	X												
PMW-3	04/18/02	4 - 14	1	X		X		X			X	X	X				
	11/23/04			X	X		X	X									
Total Number of Group 1 Samples				37	20	3	22	36	2	7	11	6	4	0	0	5	3
MW-4S	06/28/95	15 - 25	2	X			X	X		X	X					X	
	07/08/99			X			X	X									
	09/16/99			X			X	X		X	X	X					
	03/14/01			X	X		X	X			X	X					
	11/15/04			X	X		X	X									X04
	09/20/05			X	X		X	X	X								
	12/15/05			X	X		X	X	X								
	02/15/06			X	X		X	X									
	06/05/06			X	X		X	X									X06
	10/04/06			X	X		X	X	X								

Table 3-5

**Analytical Testing Summary - Groundwater Monitoring Wells
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Sample Location Identifier	Sample Date	Screened Interval (ft)	Group	VOC	1,4-Dioxane	PAH	SVOC	Metals		Cyanide	PCB	Pesticides	TPH	EPH	VPH	General Chemistry	MNA
								Total	Dissolved								
MW-4B	06/28/95	34 - 44	2	X			X	X		X	X					X	
	07/08/99			X			X	X									
	09/14/99			X			X	X		X	X	X					
	03/14/01			X	X		X	X			X	X					
	11/15/04			X	X		X	X									X04
	09/20/05			X	X		X	X									
	12/15/05			X	X		X	X									
	02/15/06			X	X		X	X									
	06/05/06			X	X		X	X									X06
	10/04/06			X	X		X	X									
MW-5	06/28/95	15 - 25	2	X			X	X		X	X					X	
	07/08/99			X			X	X									
	11/15/04			X	X		X	X	X								
	09/20/05			X	X		X	X	X								
	12/14/05			X	X		X	X	X								
	02/14/06			X	X			X									
	02/15/06						X										
	06/05/06			X	X		X	X									X06
	10/05/06			X	X		X	X	X								
	WES-04			09/13/99	unknown	2	X			X	X		X	X	X		
11/15/04		X	X				X	X									
WED-05	09/13/99	unknown	2	X			X	X		X	X	X					
	11/15/04			X	X		X	X									
Total Number of Group 2 Samples				32	22	0	32	32	7	7	9	6	0	0	0	3	5
MW-7S	06/30/99	0 - 10	3	X			X	X									
	11/17/04			X	X		X	X								X04	
	06/08/06			X	X											X06	
	10/03/06															X ⁴	
MW-7M	06/29/95	15 - 25	3	X			X	X		X	X					X	
	06/02/99			X			X	X					X	X			
	06/30/99			X			X	X									
	11/17/04			X	X		X	X								X04	
	06/08/06			X	X		X	X								X06	
MW-7R	07/01/99	37 - 47	3	X			X	X									
	11/17/04			X	X		X	X							X04		
	06/08/06			X	X										X06		
MW-9	06/23/99	15 - 25	3	X													
	06/30/99			X			X	X									
	09/17/99			X			X	X		X	X	X					
	11/17/04			X	X		X	X									
	09/21/05			X	X		X	X									
	12/19/05			X	X		X	X									
	02/15/06			X	X		X	X									
	06/08/06			X	X		X	X								X06	
	10/03/06			X	X		X	X									
	MW-10			06/30/99	15 - 25	3	X			X	X						
03/15/01		X	X				X	X			X	X					
11/17/04		X	X				X	X									
MW-16B	03/16/01	50 - 60	3	X	X		X	X			X	X					
	11/18/04			X	X		X	X									
MW-16D	03/16/01	28 - 38	3	X	X		X	X			X	X					
	11/18/04			X	X		X	X									
	06/08/06			X	X										X06		
Total Number of Group 3 Samples				28	19	0	24	24	0	2	5	4	0	1	1	1	9
MW-1S	06/29/95	2 - 11	4	X			X	X		X	X					X	
	10/30/95							X ³									
	06/02/99			X			X	X						X	X		

Table 3-5

**Analytical Testing Summary - Groundwater Monitoring Wells
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Sample Location Identifier	Sample Date	Screened Interval (ft)	Group	VOC	1,4-Dioxane	PAH	SVOC	Metals		Cyanide	PCB	Pesticides	TPH	EPH	VPH	General Chemistry	MNA	
								Total	Dissolved									
	06/28/99			X			X	X										
	09/14/99			X			X	X		X	X	X						
	03/13/01			X	X		X	X			X	X						
	11/16/04			X	X		X	X										
MW-1R	06/28/99	20 - 30	4	X			X	X										
	09/14/99			X			X	X		X	X	X						
	03/13/01			X	X		X	X			X	X						
	11/16/04			X	X		X	X										
WES-06	09/15/99	unknown	4	X			X	X		X	X	X						
	11/16/04			X	X		X	X										
WED-07	09/15/99	unknown	4	X			X	X		X	X	X						
	11/16/04			X	X		X	X										
Total Number of Group 4 Samples				14	6	0	14	15	0	5	7	6	0	1	1	1	0	
MW-8M	06/30/99	20 - 30	5	X			X	X										
	09/16/99			X			X	X		X	X	X						
	03/13/01			X	X		X	X			X	X						
	11/18/04			X	X		X	X									X04	
MW-8R	06/07/06	67 - 77	5	X	X		X	X									X06	
	06/30/99			X			X	X		X	X	X						
	09/16/99			X			X	X		X	X	X						
	03/13/01			X	X		X	X			X	X						
MW-11S	11/18/04	4 - 14	5	X	X		X	X			X	X					X04	
	06/07/06			X	X												X06	
	03/16/01			X	X		X	X										
	11/18/04			X	X		X	X		X								X04
	09/21/05			X	X		X	X										
	12/19/05			X	X		X	X										
	02/15/06			X	X		X	X										
	06/07/06			X	X		X	X										X06
	10/03/06			X	X		X	X										
	06/30/99			X			X	X										
	11/18/04			X	X		X	X		X								X04
	09/21/05			X	X		X	X										
	12/19/05			X	X		X	X										
	02/15/06			X	X		X	X										
	06/07/06			X	X		X	X										X06
	10/03/06			X	X		X	X										
MW-11D	03/16/01	53 - 63	5	X	X		X	X			X	X						
	11/19/04			X	X		X	X										
MW-13S	03/15/01	5 - 15	5	X	X		X	X			X	X						
	11/16/04			X	X		X	X										
	09/20/05			X	X		X	X										
	12/15/05			X	X		X	X										
	02/14/06			X	X		X	X										
	06/06/06			X	X		X	X										X06
	10/04/06			X	X		X	X										

Table 3-5

**Analytical Testing Summary - Groundwater Monitoring Wells
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Sample Location Identifier	Sample Date	Screened Interval (ft)	Group	VOC	1,4-Dioxane	PAH	SVOC	Metals		Cyanide	PCB	Pesticides	TPH	EPH	VPH	General Chemistry	MNA	
								Total	Dissolved									
MW-13D	07/02/99	24 - 34	5	X			X	X										
	09/15/99			X			X	X		X	X	X						
	03/15/01			X	X		X	X			X	X						
	11/16/04			X	X		X	X										
	09/20/05			X	X			X										
	12/15/05			X	X			X										
	02/14/06			X	X			X										
	06/06/06			X	X			X										X06
	10/04/06			X	X			X										
	03/15/01			43.5 - 53.5	5	X	X		X	X			X	X				
11/16/04	X	X				X	X											
09/20/05	X	X					X											
12/15/05	X	X					X											
02/14/06	X	X					X	X										
06/06/06	X	X					X										X06	
10/04/06	X	X					X	X										
09/15/99	38 - 48	5	X					X	X		X	X	X					
11/16/04			X	X		X	X											
MW-17S	03/15/01	5 - 15	5	X	X		X	X			X	X						
	11/18/04			X	X		X	X									X04	
	09/21/05			X	X			X										
	12/15/05			X	X			X										
	02/15/06			X	X			X										
	06/06/06			X	X			X										X06
	10/03/06			X	X			X										
	03/15/01			40 - 50	5	X	X		X	X			X	X				
11/18/04	X	X				X	X										X04	
09/21/05	X	X					X											
12/15/05	X	X					X											
02/15/06	X	X					X											
06/06/06	X	X					X										X06	
10/03/06	X	X					X											
03/15/01	64 - 74	5	X			X		X	X			X	X					
11/18/04			X	X		X	X										X04	
09/21/05			X	X			X											
12/15/05			X	X			X											
02/15/06			X	X			X											
06/06/06			X	X			X										X06	
10/03/06			X	X			X											
12/08/04			1 - 11	5	X	X		X	X									
12/13/05	X	X					X											
MW-21M	11/03/04	15 - 25	5	X	X			X ¹										
	12/08/04			X	X		X	X										
	12/13/05			X	X			X										
MW-22M	03/17/05	26 -36	5	X	X		X	X									X04	
	09/21/05			X	X			X										
	12/15/05			X	X			X										
	02/15/06			X	X			X										
	06/05/06			X	X			X										X06
	10/03/06			X	X			X										
MW-22B	03/17/05	56 - 66	5	X	X		X	X										
	09/21/05			X	X			X										
	12/15/05			X	X			X										
	02/15/06			X	X			X										
	06/05/06			X	X			X										
	10/03/06			X	X			X										
Total Number of Group 5 Samples				89	81	0	39	88	4	4	14	14	0	0	0	0	19	

Table 3-5

**Analytical Testing Summary - Groundwater Monitoring Wells
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Sample Location Identifier	Sample Date	Screened Interval (ft)	Group	VOC	1,4-Dioxane	PAH	SVOC	Metals		Cyanide	PCB	Pesticides	TPH	EPH	VPH	General Chemistry	MNA
								Total	Dissolved								
MW-15	07/07/99	18 - 28	6	X			X	X									
	09/15/99			X			X	X		X	X	X					
	11/15/04			X	X		X		X								
	12/08/04							X									
	06/07/06			X	X												
MW-18B	03/14/01	67 - 77	6	X	X		X	X			X	X					
	11/16/04			X	X		X	X									
MW-18D	03/14/01	49 - 59	6	X	X		X	X			X	X					
	11/16/04			X	X		X	X									
Total Number of Group 6 Samples				8	6	0	7	7	1	1	3	3	0	0	0	0	1
MW-19S	03/14/01	10 - 20	7	X	X		X	X			X	X					
	11/15/04			X	X		X	X									
	06/06/06			X	X												X06
MW-19D	03/14/01	34 - 44	7	X	X		X	X			X	X					
	11/15/04			X	X		X	X									
	06/07/06			X	X			X									X06
MW-19B	03/14/01	59 - 69	7	X	X		X	X			X	X					
	11/15/04			X	X		X	X									
MW-23B	12/08/04	48 - 58	7	X	X		X	X									X04
	09/20/05			X	X			X									
	12/14/05			X	X			X									
	02/14/06			X	X			X									
	06/07/06			X	X			X									X06
	10/05/06			X	X			X									
MW-24	12/14/05	3 - 13	7	X	X			X									
	02/09/06			X	X			X									
MW-24M	12/14/05	19.5 - 29.5	7	X	X			X									
	02/09/06			X	X			X									
MW-25	12/13/05	10 - 20	7	X	X			X									
	02/09/06			X	X			X									
MW-25M	12/14/05	23 - 33	7	X	X			X									
	02/09/06			X	X			X									
WES-01	09/13/99	unknown	7	X			X	X		X	X	X					
	11/22/04			X	X		X	X									
WED-02	09/13/99	unknown	7	X			X	X		X	X	X					
	11/22/04			X	X		X	X									
WEB-03	09/13/99	unknown	7	X			X	X		X	X	X					
	12/08/04						X	X									
	01/05/05			X	X												
PMW-4	06/04/02	2 - 10	7					X ²									
	06/13/02								X ²								
	11/09/06			X	X												
PMW-5	06/04/02	2 - 10	7					X ²									
PMW-6	06/04/02	2 - 10	7					X ²									
	09/20/05			X	X			X									
	12/14/05			X	X			X									
	02/14/06			X	X			X									
	06/07/06			X	X			X								X06	
	10/05/06			X	X			X									
Total Number of Group 7 Samples				34	31	0	13	36	0	3	6	6	0	0	0	0	5
Total Number of Group Samples				242	185	3	151	238	14	29	55	45	4	2	2	10	42

Table 3-5

**Analytical Testing Summary - Groundwater Monitoring Wells
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Sample Location Identifier	Sample Date	Screened Interval (ft)	Group	VOC	1,4-Dioxane	PAH	SVOC	Metals		Cyanide	PCB	Pesticides	TPH	EPH	VPH	General Chemistry	MNA
								Total	Dissolved								
<p>NOTE:</p> <p>ft = feet below ground surface</p> <p>X = The sample was submitted for the analysis indicated.</p> <p>X¹ = Sample analyzed for arsenic, cadmium, lead, iron, manganese, magnesium, and hardness only.</p> <p>X² = Sample analyzed for arsenic and beryllium only.</p> <p>X³ = Sample analyzed for arsenic only.</p> <p>A blank space indicates the sample was not analyzed for this constituent.</p> <p>VOC = Volatile organic compounds by EPA Method 8260 (1995), EPA Method 8260 (June 1999), EPA Method 8260B (2002, 2004-2006).</p> <p>1,4-Dioxane by EPA Method 8260B-SIM (2004-2006).</p> <p>PAH = Polynuclear aromatic hydrocarbons by EPA Method 8270C (2002).</p> <p>SVOC = Semi-volatile organic compounds by EPA Method 8270B (1995), EPA Method 8270 (June 1999), EPA Method 8270C (2004-2006).</p> <p>Total Metals = Total (unfiltered) metals by EPA 6000/7000 Series Methods (1995, 2002, 2004-2006), EPA Method 6010 and 245.1 (June 1999).</p> <p>Dissolved Metals = Metal concentrations after the water sample was passed through a 0.45 micron filter by EPA 6000/7000 Series Methods (2004-2006).</p> <p>Cyanide by EPA Method 335.3 (1995) and a Midi-Distillation Spectrophotometric Technique (1999).</p> <p>PCB = Polychlorinated biphenyls by EPA Method 608 (1995), 8082 (2002, 2005).</p> <p>Pesticides by EPA Method 8081 (2002, 2005).</p> <p>TPH = Total petroleum hydrocarbons by Standard Method 5520A, E, and F (1995), modified EPA Method 8100 (2002).</p> <p>EPH = Extractable petroleum hydrocarbons by MADEP EPH 98-1 (June 1999).</p> <p>VPH = Volatile petroleum hydrocarbons by MADEP VPH 98-1 (June 1999).</p> <p>General Chemistry = Chloride, Total Alkalinity, Nitrate, Sulfate, TDS, COD, Specific Conductivity, Ammonia-N</p> <p>Monitored Natural Attenuation (MNA); X04 = Ferrous Iron, Sulfite (except for MW-22M), Sulfide, Methane, DOC (2004); X06 = Ferrous Iron, Sulfate, Total Alkalinity, Nitrate, and Methane (2006); X⁴ = Sample analyzed for methane only.</p> <p>Chloride by Standard Method 4500-C1 B (1995).</p> <p>TDS = Total dissolved solids by Standard Method 2540 (1995).</p> <p>Alkalinity as CaCO₃ = Alkalinity as calcium carbonate by Standard Method 2320B (1995), Standard Method 310.1 (2006).</p> <p>Nitrate by EPA Method 353.1 (1995), Standard Method 4500 (2006).</p> <p>Sulfate by EPA Method 375.4 (1995 and 2006).</p> <p>COD = Chemical oxygen demand by Standard Method 5520B (1995).</p> <p>Specific Conductivity by EPA Method 120.1 (1995).</p> <p>Ammonia - N = Ammonia as Nitrogen by EPA Method 350.1 (1995).</p> <p>Ferrous Iron by EPA Method 3500 (2004 and 2006).</p> <p>Sulfite by EPA Method 377.1 (2004).</p> <p>Sulfide by EPA Method 376.2 (2004).</p> <p>Methane by Standard Gas Chromatographic Technique for dissolved methane.</p> <p>DOC = Dissolved organic carbon. Water was passed through a 0.45 micron filter by EPA Method 415.1.</p>																	

Table 3-6

**Analytical Testing Summary - Temporary Wells Groundwater
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Sample Location Identifier	Sample Date	Screen/Sample Depth Interval (ft bgs)	Group	VOC	1,4-Dioxane	SVOC	Metals		Hardness	Cyanide	PCB	Pesticide	EPH	VPH	MNA
							Total	Dissolved							
GP-1	11/11/04	2 - 12	1	X	X		X'		X						
GP-2	10/14/04	2 - 12	1	X	X		X'		X						
GP-3	10/14/04	2.2 - 12.2	1	X	X		X'		X						
GP-4	10/14/04	3.4 - 13.4	1	X	X		X'		X						
GP-5	10/14/04	8 - 18	1	X	X		X'		X						
GP-6	10/14/04	8 - 18	1	X	X		X'		X						
Total Number of Group 1 Samples				6	6	0	6	0	6	0	0	0	0	0	0
GP-9	11/11/04	10 - 20	2	X	X		X'		X						
GP-11	11/02/04	7 - 17	2	X	X		X'		X						
GP-12	10/21/04	3 - 13	2	X	X		X'		X						
GP-13	10/21/04	5 - 15	2	X	X		X'		X						
GP-14	10/21/04	3 - 13	2	X	X		X'		X						
GP-15	10/21/04	6.7 - 16.7	2	X	X		X'		X						
GP-16	10/21/04	10 - 20	2	X	X		X'		X						
Total Number of Group 2 Samples				7	7	0	7	0	7	0	0	0	0	0	0
DEP-1	06/02/99	unknown	3	X										X	
DEP-2	06/02/99	unknown	3	X		X	X						X	X	
DEP-3	06/02/99	unknown	3	X										X	
GP-23	11/11/04	15 - 25	3	X	X		X'	X							
GP-24	11/04/04	18 - 28	3	X	X		X'	X							
	06/08/06			X	X		X	X					X06		
GP-25	11/11/04	15 - 25	3	X	X		X'	X							
	06/08/06			X	X										
Total Number of Group 3 Samples				8	5	1	5	1	3	0	0	0	1	3	1
DEP-4	6/23/1999	unknown	4	X											
	9/15/1999			X		X		X	X	X					
DEP-5	6/23/1999	unknown	4	X											
Total Number of Group 4 Samples				3	0	1	1	0	0	1	1	1	0	0	0
GP-7	11/11/04	16 - 26	5	X	X		X'	X							
GP-8	11/03/04	22 - 32	5	X	X		X'	X							
GP-10	11/02/04	8 - 18	5	X	X		X'	X							
WP-8	12/19/05	2 - 4	5	X	X		X								
WP-9	12/28/05	1 - 3	5	X	X		X								
WP-10	12/28/05	2 - 4	5	X	X		X								
Total Number of Group 5 Samples				6	6	0	6	0	3	0	0	0	0	0	0
GP-18	11/04/04	19 - 24	6	X	X		X'	X							
GP-19	11/03/04	3 - 13	6	X	X		X'	X							
GP-20	11/23/04	14.5 - 24.5	6	X	X		X'	X							
GP-21	11/03/04	16.3 - 26.3	6	X	X		X'	X							
WP-6	12/28/05	1.5 - 3.5	6	X	X	X	X			X	X				
WP-7	12/28/05	8 - 10	6	X	X	X	X			X	X				
Total Number of Group 6 Samples				6	6	2	6	0	4	0	2	2	0	0	0
GP-26	11/11/04	2 - 12	7	X	X		X'	X							
Total Number of Group 7 Samples				1	1	0	1	0	1	0	0	0	0	0	0
Total Number of Samples				37	31	4	32	1	24	1	3	3	1	3	1

NOTE:
ft bgs = feet below ground surface
X = The sample was submitted for the analysis indicated.
X' = The sample was submitted for arsenic, cadmium, lead, iron, manganese, and magnesium only.
VOC = Volatile organic compounds by EPA Method 8260 (1999) and EPA Method 8260B (2004-2006).
1,4-Dioxane by EPA Method 8260B-SIM.
SVOC = Semi-volatile organic compounds by EPA Method 8270D (1999) and EPA Method 8270C (2004-2005).
Total Metals = Total (unfiltered) metals by EPA 245.1 and 6010A (1999) and EPA 6000/7000 Series Methods (2004-2005).
Dissolved Metals = Metal concentrations after the water sample was passed through a 0.45 micron filter by EPA 6000/7000 Series Methods (2004-2006).
Hardness by Method 2340B.
Cyanide by EPA Method 335.3 (1995) and a Midi-Distillation Spectrophotometric Technique (1999).
PCB = Polychlorinated biphenyls by EPA Method 8082.
Pesticides by EPA Method 8081.
EPH = Extractable petroleum hydrocarbons by MADEP EPH 98-1 (1999).
VPH = Volatile petroleum hydrocarbons by MADEP VPH 98-1 (1999).
Monitored Natural Attenuation (MNA): X06 = Ferrous Iron, Sulfate, Total Alkalinity, Nitrate, and Methane (2006).
Ferrous Iron by EPA Method 3500 (2006).
Sulfate by EPA Method 375.4 (2006).
Alkalinity as CaCO3 = Alkalinity as calcium carbonate by Standard Method 310.1 (2006).
Nitrate by Standard Method 4500 (2006).
Methane by Standard Gas Chromatographic Technique for dissolved methane.

Table 3-7

Analytical Testing Summary - Sediment
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Sample Depth (ft)	Data Group	Location Descriptor	VOC	SVOC	Metals	Cyanide	PCBs	Pesticides	TPH	AVS/SEM	Grain Size	TOC	Toxicity Test	pH
SS-12 (04)	11/09/04	0 - 1	3	AW	X	X	X		X	X				X		X
Total Number of Group 3 Samples					1	1	1	0	1	1	0	0	0	1	0	1
SD-01 (89)	10/26/89	surface	5	SB	X	X	X		X	X						
SD-03 (89)	10/26/89	surface	5	SB	X	X	X		X	X						
SD001 (95)	06/27/95	0 - 0.5	5	SB			X	X	X		X					
	10/30/95				X											
SD002 (95)	06/27/95	0 - 0.5	5	SB			X	X	X		X		X			
	10/30/95				X											
SD003 (95)	06/27/95	0 - 0.5	5	SB			X	X	X		X					
	10/30/95				X											
SD-14 (99)	08/10/99	0 - 0.5	5	T	X	X	X	X	X	X						
SD-15 (99)	08/10/99	0 - 0.5	5	T			X									
SD-16 (99)	08/09/99	0 - 0.5	5	T	X	X	X	X	X	X						
SD-17 (99)	08/09/99	0 - 0.5	5	T			X									
SD-20 (99)	08/10/99	0 - 0.5	5	SB	X	X	X	X	X	X						
SD-21 (99)	08/10/99	0 - 0.5	5	SB	X	X	X	X	X	X						
SD-22 (99)	08/09/99	0 - 0.5	5	SB	X	X	X	X	X	X						
SD-23 (99)	08/09/99	0 - 0.5	5	SB	X	X	X	X	X	X						
SD-24 (99)	08/09/99	0 - 0.5	5	SB	X	X	X	X	X	X						
SD-25 (99)	08/09/99	0 - 0.5	5	SB	X	X	X	X	X	X						
SD-26 (99)	08/09/99	0 - 0.5	5	SB	X	X	X	X	X	X						
SD-28 (99)	08/09/99	0 - 0.5	5	SB	X	X	X	X	X	X						
SD-31 (04)	10/22/04	0 - 0.5	5	SB	X	X	X		X	X		X		X		
SD-32 (04)	10/22/04	0 - 0.5	5	SB	X	X	X		X	X		X	X	X		
SD-33 (04)	10/22/04	0 - 0.5	5	SB	X	X	X		X	X		X	X	X		
SD-34 (04)	10/22/04	0 - 0.5	5	SB	X	X	X		X	X		X	X	X		
SD-35 (04)	10/22/04	0 - 0.5	5	SB	X	X	X		X	X			X	X		
SD-36 (04)	10/21/04	0 - 0.5	5	SB	X	X	X		X	X		X	X	X		
SD-37 (04)	10/21/04	0 - 0.5	5	SB	X	X	X		X	X			X	X		
SD-43 (04)	10/22/04	0 - 0.5	5	T	X	X	X		X	X			X	X		
WS-7 (04)	11/09/04	0 - 1	5	AW	X	X	X		X	X				X		X
WS-10 (04)	11/18/04	0 - 2	5	AW	X	X	X		X	X				X		X
WS-11 (04)	11/18/04	0 - 2	5	AW	X	X	X		X	X				X		X
WS-15 (04)	11/18/04	0 - 2	5	AW	X	X	X		X	X				X		X
WS-16 (04)	11/18/04	0 - 2	5	AW	X	X	X		X	X				X		X
SD-38 (04)	11/18/04	0 - 2	5	T	X	X	X		X	X		X	X	X		
SD-202 (06)	11/09/06	0 - 0.5	5	T			X ²									
SD-203 (06)	11/09/06	0 - 0.5	5	T			X ²									
SD-204 (06)	11/09/06	0 - 0.5	5	T			X ²						X		X	
SD-205 (06)	11/09/06	0 - 0.5	5	T			X ²									
SD-206 (06)	11/09/06	0 - 0.5	5	T			X ²						X		X	
SD-207 (06)	11/09/06	0 - 0.5	5	T			X ²						X		X	
SD-208 (06)	11/17/06	0 - 0.5	5	SB			X ²									
SD-209 (06)	11/10/06	0 - 0.5	5	SB			X ²									
SD-210 (06)	11/10/06	0 - 0.5	5	SB			X ²									
SD-211 (06)	11/10/06	0 - 1	5	SB			X ²									
SD-212 (06)	11/10/06	0 - 1	5	SB			X ²									
SD-213 (06)	11/10/06	0 - 1	5	SB			X ²									
SD-214 (06)	11/09/06	0 - 0.5	5	SB	X	X	X							X		
SD-215 (06)	11/09/06	0 - 0.5	5	SB	X	X	X							X		
Total Number of Group 5 Samples					31	28	45	13	29	26	3	6	13	16	3	5
SD-01 (99)	08/10/99	0 - 0.5	6	AW	X	X	X	X	X	X						
SD-02 (99)	08/10/99	0 - 0.5	6	AW	X	X	X	X	X	X						
SD-39 (04)	10/28/04	0 - 0.5	6	PD	X	X	X		X	X			X	X		
SD-40 (04)	10/22/04	0 - 0.5	6	PD	X	X	X		X	X			X	X		
SD-41 (04)	10/22/04	0 - 0.5	6	PD	X	X	X		X	X			X	X		
SD-42 (04)	10/28/04	0 - 0.5	6	PD	X	X	X		X	X			X	X		
WS-101 (05)	12/01/05	0 - 1	6	AW	X	X	X		X	X				X		X

Table 3-7

Analytical Testing Summary - Sediment
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Sample Depth (ft)	Data Group	Location Descriptor	VOC	SVOC	Metals	Cyanide	PCBs	Pesticides	TPH	AVS/SEM	Grain Size	TOC	Toxicity Test	pH
WS-102 (05)	12/01/05	0 - 1	6	AW	X	X	X		X	X				X		X
WS-103 (05)	12/01/05	0 - 1	6	AW	X	X	X		X	X				X		X
WS-104 (05)	12/01/05	0 - 1	6	AW	X	X	X		X	X				X		X
WS-105 (05)	12/01/05	0 - 1	6	AW	X	X	X		X	X				X		X
SD-216 (06)	11/09/06	0 - 0.5	6	AW	X	X	X ¹						X	X		
SD-217 (06)	11/09/06	0 - 0.5	6	AW	X	X	X ¹							X		
SD-218 (06)	11/09/06	0 - 1	6	AW	X	X	X ¹							X		
SD-219 (06)	11/09/06	0 - 0.5	6	AW	X	X	X ¹							X		
SD-220 (06)	11/09/06	0 - 1	6	AW	X	X	X ¹							X		
SD-221 (06)	11/09/06	0 - 0.5	6	AW	X	X	X ¹							X		
Total Number of Group 6 Samples					17	17	17	2	11	11	0	0	5	15	0	5
SD-02 (99)	10/26/99	surface	7	R-SB	X	X	X		X	X						
SD-06 (99)	08/09/99	0 - 0.5	7	R-SB	X	X	X	X	X	X						
SD-07 (99)	08/09/99	0 - 0.5	7	R-SB			X									
SD-18 (99)	08/09/99	0 - 0.5	7	R-SR	X	X	X	X	X	X						
SD-19 (99)	08/09/99	0 - 0.5	7	R-SR			X									
SD-30 (99)	08/09/99	0 - 0.5	7	R-SR	X	X	X	X	X	X						
SD-31 (99)	08/09/99	0 - 0.5	7	R-SR	X	X	X	X	X	X						
SD-33 (99)	08/09/99	0 - 0.5	7	R-SR	X	X	X	X	X	X						
SD-10 (99)	08/10/99	0 - 0.5	7	R-SB	X	X	X	X	X	X						
SD-11 (99)	08/10/99	0 - 0.5	7	R-SB			X									
SD-30 (04)	11/23/04	0 - 0.5	7	R-SB	X	X	X		X	X			X	X		
SD-200 (06)	11/10/06	0 - 0.5	7	R-T			X ²						X		X	
SD-201 (06)	11/10/06	0 - 0.5	7	R-T			X ²						X		X	
Total Number of Group 7 Samples					8	8	13	6	8	8	0	0	3	1	2	0
Total Number of Samples					57	54	76	21	49	46	3	6	21	33	5	11
NOTE: ft = feet below top of sediment X = The sample was submitted for the analysis indicated. X ¹ = The sample was submitted for analysis of mercury only. X ² = The sample was submitted for analysis of arsenic and iron only. A blank space indicates the sample was not analyzed for this constituent. VOC = Volatile organic compounds by CLP VOC Analysis (1989) or EPA Method 8260B. SVOC = Semi-volatile organic compounds by CLP Extractable Organic Analysis (1989) or EPA Method 8270. Metals by CLP Inorganic Analysis (1989) or EPA method 6000/7000 series. PCB = Polychlorinated biphenyls by CLP Extractable Organic Analysis (1989) or EPA method 8082. Pesticides by CLP Extractable Organic Analysis (1989) or EPA Method 8081 and 8081A. AVS/SEM = Acid volatile sulfide/simultaneous extracted metals. TPH = Total petroleum hydrocarbons. Grain Size by sieve ASTM C-117 and C-136. TOC = Total organic carbon by Lloyd Kahn (2004-2006). pH by EPA Method 9045C. AW = Aquatic Wetland PD = Pond R-SR = Reference - Shawsheen River R-SB = Reference - Sutton Brook R-T = Reference - Tributary to Sutton Brook T = Tributary to Sutton Brook SB = Sutton Brook																

Table 3-8

**Analytical Testing Summary - Surface Water
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Sample Location Identifier	Sample Date	Sample Depth (ft)	Data Group	Location Descriptor	VOC	1,4-Dioxane	SVOC	Metals		Cyanide	PCBs	Pesticides	EPH	VPH	Hardness	Nitrate	Sulfate	Chloride	TDS	Alkalinity (Total)	Ammonia - Nitrogen	Specific Conductivity	COD
								Total	Dissolved														
SW-111 (05)	12/02/05	0 - 0.5	3	AW	X	X		X	X						X	X	X						
Total Number of Group 3 Samples					1	1	0	1	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0
SW001 (95)	06/27/95	surface	5	SB			X	X		X						X	X	X	X	X	X	X	X
	10/30/95				X																		
SW002 (95)	06/27/95	surface	5	SB			X	X		X						X	X	X	X	X	X	X	X
	10/30/95				X																		
SW003 (95)	06/27/95	surface	5	SB			X	X		X						X	X	X	X	X	X	X	X
	10/30/95				X																		
SW1-99	06/02/99	surface	5	SB	X		X	X					X	X									
SW2-99	06/02/99	surface	5	SB	X		X	X					X	X									
SW3-99	06/02/99	surface	5	SB	X		X	X					X	X									
SW4-99	06/03/99	surface	5	SB	X		X	X					X	X									
SW-02 (99)	08/09/99	surface	5	SB	X		X	X		X	X	X											
SW-03 (99)	08/09/99	surface	5	SB	X		X	X		X	X	X											
SW-05 (99)	08/10/99	surface	5	SB	X		X	X		X	X	X											
SW-08 (99)	08/09/99	surface	5	T	X		X	X		X	X	X											
SW-09 (99)	08/10/99	surface	5	T	X		X	X		X	X	X											
SW-10 (99)	08/10/99	surface	5	SB	X		X	X		X	X	X											
SW-31 (04)	10/22/04	0 - 0.5	5	SB	X	X	X	X	X		X	X			X	X	X						
SW-32 (04)	10/22/04	0 - 0.5	5	SB	X	X	X	X	X		X	X			X	X	X						
SW-33	10/22/04	0 - 0.5	5	SB	X	X	X	X	X		X	X			X	X	X						
	09/02/05				X	X		X	X														
	02/16/06				X	X		X	X														
	10/05/06				X	X		X	X														
SW-34 (04)	10/22/04	0 - 0.5	5	SB	X	X	X	X			X	X			X	X	X						
SW-35 (04)	10/22/04	0 - 0.5	5	SB	X	X	X	X	X		X	X			X	X	X						
SW-36	10/21/04	0 - 0.5	5	SB	X	X	X	X	X		X	X			X	X	X						
	09/20/05				X	X		X	X														
	02/16/06				X	X		X	X														
	10/05/06				X	X		X	X														
SW-37	10/21/04	0 - 0.5	5	SB	X	X	X	X			X	X			X	X	X						
	09/20/05				X	X		X	X														
	02/16/06				X	X		X	X														
	10/05/06				X	X		X	X														
SW-38 (04)	10/21/04	0 - 0.5	5	T	X	X	X	X			X	X			X	X	X						
SW-43 (04)	10/22/04	0 - 0.5	5	T	X	X	X	X			X	X			X	X	X						
SW-106 (05)	12/02/05	0 - 0.5	5	AW	X	X		X	X						X	X	X						
SW-107 (05)	12/02/05	0 - 0.5	5	AW	X	X		X	X						X	X	X						
SW-108 (05)	12/01/05	0 - 0.5	5	AW	X	X		X	X						X	X	X						
SW-109 (05)	12/01/05	0 - 0.5	5	AW	X	X		X	X						X	X	X						
SW-110 (05)	12/02/05	0 - 0.5	5	AW	X	X		X	X						X	X	X						
SW-214 (06)	11/09/06	0 - 0.5	5	SB	X	X	X		X						X								
SW-215 (06)	11/10/06	0 - 0.5	5	SB	X	X	X		X						X								
Total Number of Group 5 Samples					38	25	24	36	20	9	15	15	4	4	16	17	17	3	3	3	3	3	3
SW-39 (04)	10/28/04	0 - 0.5	6	PD	X	X	X	X	X		X	X			X	X	X						
SW-40 (04)	10/22/04	0 - 0.5	6	PD	X	X	X	X			X	X			X	X	X						

Table 3-8

**Analytical Testing Summary - Surface Water
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Sample Location Identifier	Sample Date	Sample Depth (ft)	Data Group	Location Descriptor	VOC	1,4-Dioxane	SVOC	Metals		Cyanide	PCBs	Pesticides	EPH	VPH	Hardness	Nitrate	Sulfate	Chloride	TDS	Alkalinity (Total)	Ammonia - Nitrogen	Specific Conductivity	COD
								Total	Dissolved														
SW-41 (04)	10/22/04	0 - 0.5	6	PD	X	X	X	X			X	X			X	X	X						
SW-42 (04)	10/28/04	0 - 0.5	6	PD	X	X	X	X			X	X			X	X	X						
SW-101 (05)	12/01/05	0 - 0.5	6	AW	X	X	X	X	X		X	X			X	X	X						
SW-102 (05)	12/05/05	0 - 0.5	6	AW	X	X	X	X	X		X	X			X	X	X						
SW-103 (05)	12/01/05	0 - 0.5	6	AW	X	X	X	X	X		X	X			X	X	X						
SW-104 (05)	12/01/05	0 - 0.5	6	AW	X	X	X	X	X		X	X			X	X	X						
SW-105 (05)	12/01/05	0 - 0.5	6	AW	X	X	X	X	X		X	X			X	X	X						
Total Number of Group 6 Samples					9	9	9	9	6	0	9	9	0	0	9	9	9	0	0	0	0	0	0
SW-01 (99)	08/09/99	surface	7	R-SR	X		X	X		X	X	X											
SW-07 (99)	08/09/99	surface	7	R-SR	X		X	X		X	X	X											
SW-11 (99)	08/10/99	surface	7	R-SB	X		X	X		X	X	X											
SW-30	11/23/04	0 - 0.5	7	R-SB	X	X	X	X			X	X			X	X	X						
	09/20/05				X	X		X	X														
	02/16/06				X	X		X	X														
	10/05/06				X	X		X	X														
SW-222 (06)	11/09/06	0 - 0.5	7	R-SB					X						X								
Total Number of Group 7 Samples					7	4	4	7	4	3	4	4	0	0	2	1	1	0	0	0	0	0	0
Total Number of Samples					55	39	37	53	31	12	28	28	4	4	28	28	28	3	3	3	3	3	3
<p>NOTE:</p> <p>ft = feet below the surface of the water.</p> <p>X = The sample was submitted for the analysis indicated.</p> <p>A blank space indicates the sample was not analyzed for this constituent.</p> <p>VOC = Volatile organic compounds by EPA Method 8260 (1995), 8260A (June 1999), 8260B (2004-2006).</p> <p>1,4-Dioxane by EPA Method 8260B (2004-2006).</p> <p>SVOC = Semi-volatile organic compounds by EPA Method 8270B (1995), 8270D (June 1999), and 8270C (2004-2006).</p> <p>Total Metals = Total (unfiltered) metals by EPA 6000/7000 Series Methods (1995, 2004-2006), 200 Series Methods (June 1995).</p> <p>Dissolved Metals = Metal concentrations after the water sample was passed through a 0.45 micron filter by EPA 6000/7000 Series Methods (2004-2006).</p> <p>Cyanide by EPA Method 335.3 (1995).</p> <p>Hardness by Method 2340B.</p> <p>PCB = Polychlorinated biphenyls by EPA Method 8082.</p> <p>Pesticides by EPA Method 8081A (2004 and 2005).</p> <p>EPH = Extractable petroleum hydrocarbons by MADEP EPH 98-1 (June 1999).</p> <p>VPH = Volatile petroleum hydrocarbons by MADEP VPH 98-1 (June 1999).</p> <p>Nitrate - Nitrogen by EPA Method 353.1.</p> <p>Sulfate by EPA Method 375.4.</p> <p>Chloride by Standard Method 4500-C1B.</p> <p>TDS = Total dissolved solids by Method SM 2540C.</p> <p>Alkalinity by Standard Method 2320B.</p> <p>Ammonia - Nitrogen by EPA Method 350.1.</p> <p>Specific Conductivity by EPA Method 120.1.</p> <p>COD = Chemical oxygen demand by Standard Method 5220B.</p> <p>AW = Aquatic Wetland</p> <p>PD = Pond</p> <p>R-SR = Reference - Shawsheen River</p> <p>R-T = Reference - Tributary to Sutton Brook</p> <p>T = Tributary to Sutton Brook</p> <p>SB = Sutton Brook</p>																							

Table 3-9

**Analytical Testing Summary - Ambient Air
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Sample Location Identifier	Sample Depth (ft)	Sample Date	Group	VOC
STA 1 (92)	2 - 3	08/21/92	1	X
STA 2 (92)	above eroded area	08/21/92	1	X
STA 3 (92)	above eroded area	08/21/92	1	X
STA 5 (92)	above eroded area	08/21/92	1	X
STA 6 (92)	above eroded area	08/21/92	1	X
Total Number of Group 1 Samples				5
STA 4 (92)	4 - 5	08/21/92	2	X
Total Number of Group 2 Samples				1
STA 7 (92)	4 - 5	08/21/92	7	X
Total Number of Group 7 Samples				1
NOTE: All samples were grab samples collected with Summa canisters. ft = feet above ground surface X = The sample was submitted for the analysis indicated. VOC = Volatile organic compounds by a modified EPA Method TO-14.				

Table 3-10

**Analytical Testing Summary - Landfill Gas
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Sample Location Identifier	Sample Depth (ft)	Sample Date	Group	VOC	% Methane	% Oxygen	Hydrogen Sulfide (ppmV)
LFG-1 (95)	just below surface	06/30/95	1	X	X	X	X
LFG-2 (95)	just below surface	06/30/95	1	X	X	X	X
LFG-3 (95)	just below surface	06/30/95	1	X	X	X	X
SG-1 (04)	2	10/28/04	1	X	X	X	X
SG-2 (04)	2	10/28/04	1	X	X	X	X
SG-3 (04)	2	10/28/04	1	X	X	X	X
Total Number of Group 1 Samples				6	6	6	6
SG-4 (04)	2	10/28/04	2	X	X	X	X
SG-5 (04)	2	10/28/04	2	X	X	X	X
Total Number of Group 2 Samples				2	2	2	2
NOTE: ft = feet below ground surface X = The sample was submitted for the analysis indicated. VOC = Volatile organic compounds by EPA Methods TO-14 (1995) and TO-15 (2004). % = percent ppmV = parts per million by volume % Methane, % Oxygen, and Hydrogen Sulfide were analyzed in the field; Locations SG-6 (06), SG-7 (06), and SG-8 (06) were also field monitored for these parameters in December 2006-January 2007 to evaluate landfill gas migration potential (included in FS).							

Table 3-11

Analytical Testing Summary - Leachate
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Sample Depth (ft)	Group	VOC	SVOC	Metals	PCB	Pesticide
LF-1 (05)	04/25/05	Surface	1	X	X	X	X	X
Total Number of Group 1 Samples				1	1	1	1	1
LF-2 (05)	04/25/05	Surface	2	X	X	X	X	X
Total Number of Group 2 Samples				1	1	1	1	1
NOTE: ft = feet below ground surface. X = The sample was submitted for the analysis indicated. VOC = Volatile organic compounds by EPA Method 8260B. SVOC = Semi-volatile organic compounds by EPA Method 8270C. Total Metals = Total metals by EPA 6000/7000 Series Methods. PCB = Polychlorinated biphenyls by 8082. Pesticides by EPA Method 8081.								



4. ENVIRONMENTAL SETTING

The presentation and evaluation of the environmental setting has been based on a review and interpretation of available published and unpublished reports including site-specific data collected for this RI and other data obtained during un-related investigations in the area. The following presents a discussion of the environmental setting including:

- Geologic Setting (Section 4.1),
- Hydrologic Setting (Section 4.2),
- Hydrogeologic Setting (Section 4.3), and
- Climatological Conditions (Section 4.4).

4.1 GEOLOGIC SETTING

The majority of the Site is unpaved and relatively flat, aside from the steeply sloped landfill lobes. The overburden geology of the area is characterized by glacial features (e.g., outwash and till deposits). Surface morphology includes small streams and wetland areas. Approximately 12,000 to 14,000 years ago during the last major ice advance, the glacial ice sheet moved southward, forming or reshaping hills, valleys were deepened, lowlands were buried, and some streams were diverted. Much of the displaced rock material was re-deposited from the glacial ice as till soil.

As the glaciers melted, soil and rock fragments from within the ice were transported, sorted, and deposited by melt-water as stratified drift along stream channels, in lakes and in the ocean. Stream channel deposits, also known as fluvial deposits, consist largely of sand and gravel deposited by melt-water at the sides, terminus, or further downstream of the melting glacier. Regional lacustrine deposits consist of gravel, sand, silt, and clay that settled on the bottom of former lakes. The coarser material is generally contained within the deltas of streams that entered the lakes; the finer material settled in the deeper parts of the lakes.

The USGS surficial geology map of the area is presented as Figure 4-1. As shown on this map, the surficial geology of the site is made up of swamp deposits, kame plain deposits, and kame terrace deposits. Prior to the landfill, the majority of the site was swamp (see Figure 4-1). These swamps are comprised of peat and muck interbedded or intermixed with sand and silt and range in thickness from one to four feet.

Kames are round or irregular shaped sand and gravel features. A kame plain deposit is mapped in the areas of the former drum disposal area, northern portion of the northern lobe, and residential neighborhood of Bemis Circle and Serenity Drive. A kame terrace deposit is mapped in the area around the former Rocco residence and storage area and areas on the Perkins property. Kame terrace deposits have smooth, flat tops sometimes rising only a few feet above the adjacent to low lying areas (Castle, USGS, 1959).

The site-specific unconsolidated materials underlying these surficial deposits consist primarily of sand layers (stratified drift) underlain by a till laid down on top of bedrock. Depth to rock at the Site ranges from 20 to 60 feet below ground surface (ft bgs). An interpretive representation of the subsurface geology is provided as three cross sections in Figures 4-2a, 4-2b, and 4-2c. Each figure provides the location of the cross-section line in the upper left hand corner of the figure. These cross-sections are based on the soil borings completed or reviewed during the RI investigation. Based on this information the following paragraphs provide a short description of overburden and bedrock geology.



The ground surface across the Site consists of landfill lobes or fill areas, wetland soils, or an upper sand layer. The upper sand layer (10 to 45 feet in thickness) is comprised of a brown to gray medium to fine sand with a little silt and exists across the entire site. The units underlying this layer are controlled by the depth to bedrock and the presence and thickness of the till layer. In areas of deeper bedrock, coarser sand with some gravel was encountered beneath this upper sand, as seen on the western portion of the Site.

A layer of till (2 to 20 feet in thickness) overlies the bedrock in most areas of the Site. Others have indicated that there are two general types of till in the region. An upper till is generally very sandy, bouldery, and loosely compacted and may contain silt and clay with lenses of sand and gravel. A lower till is more compact, less bouldery and contains more clay and silt than the sandy till (Castle, USGS, 1959). Based on the soils encountered in the soil borings, it appears that this lower till (denser, more compact till with more silt and clay) was encountered underlying the majority of the site, specifically in the central portion for the Site.

As shown on the bedrock geology map of the area (Figure 4-3), the underlying rocks consist of both igneous and metamorphic rocks. The mapped rock along with the rock cores obtained during the RI, indicate that two types of rock were encountered beneath the Site. A granite or granodiorite, referred to as the Andover Granite, is classified as a light to medium-gray, foliated, medium to coarse grained muscovite-biotite granite with pegmatite masses. A weathered zone was observed at the top of the rock followed by more competent rock with moderate fracturing. Rock quality designations (RQDs) ranged from 0 to 92%.

The other rock type, a gneiss, is classified as a thin bedded to massive amphibolite; minor biotite gneiss. A weathered zone was also observed at the top of the rock followed by more competent rock with moderate fractures. Rock quality designations (RQDs) ranged from 0 to 100%. At several of the locations both the granite and gneiss rock types were encountered. A summary of the rock identified at each of the bedrock core locations is presented in Table 4-1 below.

Table 4-1 Summary of Rock Types Identified in Bedrock Cores

Location	Rock Type
MW-2B	Granite/Granodiorite
MW-3B	Granodiorite
MW-4B	Granodiorite
MW-8R	Granite
MW-19B	Granite
MW-1R	Gneiss
MW-7R	Gneiss
MW-13B	Gneiss
MW-23B	Gneiss
MW-17B	Granite over amphibolite
MW-18B	Gneiss over granite
MW-19B	Granite
MW-22B	Granite
MW-23B	Granodiorite over Gneiss

Unlike the ground surface topography (aside from the landfills), the bedrock surface topography varies considerably across the site. A principle feature of the area bedrock are the valleys cut by pre-glacial streams. These valleys can be effectively masked by current streams whose position is controlled by post-glacial conditions (Baker, 1964). This condition is observed beneath the Site.



An approximate configuration of the bedrock surface across the Site is presented on Figure 4-4. Bedrock surface elevations range from approximately an elevation of 80 feet above the North American Datum of 1988 (NAD88) on the northwest portion of the site (bedrock outcrop along Sutton Brook) to less than 20 feet (NAD88) in a valley located on the southwestern portion of the site and 0 feet (NAD88) adjacent to Sutton Brook on the southeast portion of the Site.

As shown on Figure 4-4, the bedrock surface generally slopes in a southerly to southwesterly direction across the site. As described above, the valley on the southwestern portion of the site was filled with glacial drift deposits creating a higher transmissive water zone (e.g., the Town's former Poplar Street wellfield). The other valley on the extreme southeastern portion of the site (upgradient portion of the Site) may be influenced by a mapped fault line in this vicinity (see Figure 4-3).

4.2 HYDROLOGIC SETTING

The main hydrologic feature at the Site is Sutton Brook and associated tributaries and wetlands. Sutton Brook is a medium gradient stream that includes both moderately moving water through established banks and slower moving water through much wider and less-established channels. The stream bed is comprised of sand and gravel with some areas of muck and peat. As shown on Figure 4-5, Sutton Brook originates in an upland area north of the Site in Andover and flows southerly, turning westerly to northerly through the site with discharge to the Shawsheen River approximately 2,500 feet northwest of South Street.

The Shawsheen River basin includes parts of 12 municipalities and drains a 77 square mile area in eastern Massachusetts. The Shawsheen River basin is classified as a Class B surface water body. These waters are designated as a habitat for fish, other aquatic life, and wildlife, and for primary and secondary contact recreation (i.e., boating, fishing, etc.). Where designated they may also be suitable for public water supply with treatment; however, no surface water in the area of the site is used as a public water supply. The southern boundaries of the basin are depicted on Figure 4-5. The Shawsheen River begins in Bedford, flows north-eastward for about 25 miles, and is joined by many small tributaries before entering the Merrimack River in Lawrence. In its upstream half, the river flows in a well-defined channel that meanders over a 200 to 600 foot-wide grassy flood plain. In its downstream half, the river flows through a gently curving pool and riffle channel that is crossed by several dams (USGS, 1980).

The Shawsheen River is characterized by streams that have low gradients that when combined with poor drainage result in numerous wetlands. From the headwaters area to the USGS stream-gauging station near Wilmington, a distance of about 11 river miles, the channel slope of the Shawsheen River is about 5 feet per mile.

As Sutton Brook traverses the Site, the character of the brook is affected by the channel width, the channel depth, the composition of the soils underlying the brook, and tributaries that contribute to the brook. At its narrowest and shallowest point, on the neighboring property northeast of the Site, the brook is approximately 3 feet wide by 1 foot deep. This area was not observed to be completely dry at any point during the investigation, but differences in the stream width and surface water flow were evident between low and high water conditions. From this area, the brook enters the site through a culvert, which passes underneath the access road (former railroad bed). The brook then gradually becomes both wider and deeper, as a clearly defined channel forms adjacent to and between the two landfill lobes. The stream bed from the culvert at the access road, to the westward bend around the northern lobe is primarily gravel and sand.

As the brook enters the area between the landfill lobes, it passes through a culvert underneath the crossing between the two landfill lobes. (Note: During the June 2006 sampling and monitoring period, due to the large precipitation events that occurred in May 2006, the crossing between the two landfill lobes was observed to be washed out.) After this intermediate culvert, the channel remains, though the depth becomes less defined, as the bottom changes to muck and peat. The brook passes between the landfill



lobes until opening up into a wetland south of the former drum disposal area (and northwest of the southern lobe). It is in this area, where the channel is widest and deepest, approximately 30 feet wide by 5 feet deep. It is also at this point, that during high water, along with groundwater discharge and contributions from its tributaries, the brook tops its banks creating the aquatic wetland that covers the western portion of the Site. As the brook passes through the area north of the adjoining residential neighborhood, the channel reforms prior to flowing out of the culvert that passes under South Street and eventually to the Shawsheen River.

Along its path, additional flow is discharged to the brook via three separate tributaries. One tributary flows northerly, draining a wetland area southeast of the site and discharging into the brook on the southeast side of the site. Another tributary flows northerly, draining an area south of the Site and discharging into the brook on the western portion of the Site. The third tributary flows southerly, draining a wetland area north of the site and discharging into the brook on the northwest portion of the site.

The results of the stream gauging performed during the RI are provided in Table 4-2. A total of eight locations (SG-A to SG-I) along Sutton Brook and its tributaries were measured during six events from November 2004 to October 2006. The stream gauging locations are shown on Figure 2-3. As indicated on Table 4-2, Sutton Brook experiences significant changes in flow between the lower water and higher water seasons. For example, estimated water flow increased approximately 3,500 gallons per minute at the culvert between the two lobes from the September 2005 event to the June 2006 event.

At times of low water (late summer and early fall), the smaller tributaries (southeast of the site and north of the site) have areas that dry-up or form smaller, trickling channels through the muck and peat found in those areas. Measurements taken from stream gauging rods and from well piezometers along the brook show that the surface water elevation varies as much 1 foot from low to high water conditions and that groundwater elevation (near the brook) varies as much as 4 feet from low to high water conditions.

In combination with the water table elevations measured across the site at the same time as the stream gauging, these events aid in understanding the site groundwater-surface water flow interactions as well as any contributions from tributaries to Sutton Brook, incorporating seasonal variation. Overall, groundwater was found to be discharging to the brook; whereas the wetlands area and smaller tributaries experienced variable elevations suggesting periods of groundwater discharge and recharge throughout the seasons.

As indicated previously, the majority of the site (outside of the brook and aside from the landfill lobes) consists of wetland areas. Several individual wetland areas were identified during the RI as follows (see Figure 4-6 for locations):

- Very large red maple swamp/floodplain associated with Sutton Brook (> 50 acres)
- Small, shallow, isolated, man-made pond (approximately 2 acres)
- Isolated land subject to flooding
 - Isolated, relatively small forested wetland (man-made)
 - Borrow pit (man-made)
 - Isolated emergent wetland

As indicated on Figure 4-6, the red maple swamp is a significant feature across the entire site. It includes floodplain and wetland basins associated with Sutton Brook and the tributary streams. The soils in this area are deep organics underlain by sandy loams.

The area south of the southern lobe is located on the southern portion of the Site and is mainly comprised of a shallow pond and dirt trails currently used by recreational vehicles. The pond appears man-made given the presence of a berm along the pond's edge and exposed sand substrates, which suggest past



excavation activities. Another feature within this area is an isolated forested wetland located northeast of the pond and adjacent to the southern lobe. Portions of this area also appear to be man-made as a result of past excavation activities and contributes to Sutton Brook as a seasonal tributary that feeds into the aquatic wetland northwest of the southern lobe.

The mapped 100 year flood water elevation is presented as Figure 4-7. This figure includes both the configuration of the 100 year floodplain as determined by on site field investigations and as provided in existing Federal Emergency Management Agency (FEMA) flood information. As shown on Figure 4-7, the 100 year flood water elevation specific to the Site is mapped to the 82 foot contour line west (downstream) of the intermediate culvert across Sutton Brook and to the 84 foot contour line east (upstream of the culvert). The 10-year flood water elevation is approximately 0.5 feet lower in elevation than the 100 year flood elevation.

Additional information on the wetland and floodplain delineation is provided in Appendix G.

4.3 HYDROGEOLOGIC SETTING

The principal aquifers in the Shawsheen River basin are composed of unconsolidated sand and gravel deposits. The most productive of these aquifers sustain well yields of several hundred gallons per minute (gpm). Aquifers that sustain well yields of less than 200 gal/min occur in many tributary-stream valleys and wetland areas. These aquifers are generally less than 50 feet thick and have small surface areas. Bedrock formations in the area of the Site are relatively impervious and yield small amounts of water from thin fractures. Bedrock wells may yield up to 100 gal/min, but generally yield much less. The median yield of 26 bedrock wells installed in this basin is 10 gal/min (USGS, 1980).

These consolidated aquifers are ordinarily recharged via percolation through the overlying glacial deposits – till and stratified drift. Tills typically have low permeabilities and specific yields that significantly limit the rate and volume of water movement. These deposits are generally considered to be moderately impervious boundaries to groundwater flow within the stratified drift deposits.

Stratified drift deposits are somewhat permeable when compared to the till and bedrock layers. Most groundwater which is present in the area of the Site flows through these deposits. The major water-bearing stratified drift formations at the Site are the outwash deposits. The stratified drift aquifer in the area of the Site is recharged from precipitation and from the brooks within the drainage basin.

To characterize groundwater flow across the site, potentiometric surveys were conducted between October 2004 and October 2006 during which water level measurements were made at the monitoring wells and stream piezometers installed at the site at the time of each survey. The October 2004, as well as the November 2004 water level rounds were conducted early in the RI program to get an initial understanding of groundwater flow and depths to groundwater. As such, many of the RI wells currently used to evaluate groundwater flow patterns were either not installed or access was not granted to those wells at that time. As such, the RI presents data from the following events December 2004, April 2005, September 2005, December 2005, February 2006, May 2006, and October 2006. These events are representative of the seasonal variations observed at the Site.

The survey results were used to develop water table and potentiometric contour maps to evaluate the direction of groundwater flow. The groundwater altitudes measured at each location during the potentiometric surveys are presented in Table 4-3. Depth to groundwater at the site ranges from approximately near/at ground surface to 12 feet below ground surface. Groundwater altitudes (relative to NAD 88) ranged from 76 feet (WP-01[04], in the brook) during the April 2005 event to 94 feet (B-24-OW, upgradient Perkins property well) during the May 2006 event. The average groundwater elevation in September 2005 was approximately 2.16 feet below the average groundwater measured in May 2006.

Differences between the average groundwater elevations measured during the seven seasonal surveys conducted from December 2004 to October 2006 are presented in Table 4-4.



Table 4-4 Seasonal Differences in Average Groundwater Elevation

Event	December 2004	April 2005	September 2005	December 2005	February 2006	May 2006	October 2006
Event Description	Moderate	Moderate-High	Low Water	Moderate	Moderate-High	High Water	Low Water
Groundwater Elevation (AVG)	80.79	81.27	79.23	80.80	81.24	81.39	79.92
Difference (Relative to Low)	+1.56	+2.04	--	+1.57	+2.01	+2.16	+0.69
Difference (Relative to High)	-0.60	-0.12	-2.16	-0.59	-0.15	--	-1.47

Notes:

1. Average groundwater elevation includes measurements made at on-site water table monitoring wells during each monitoring event and does not include measurements made at monitoring points located on adjacent properties (PSI wells on the Perkins Property, Town Wells, Krochmal Farm Wells, and those wells located in the residential area west of the Site).

Of the seven events, the September 2005 and October 2006 represent low water conditions at the Site, while the April 2005 and May 2006 represent high water conditions. The data collected after December 2005 are the more complete potentiometric surveys due to the inclusion of the monitoring wells and well points installed during the Phase 1B RI field activities (MW-24/24M, MW-25/25M, and WP-6 through WP-13).

In general, the water table surface (i.e., top of the groundwater surface) mimics the natural land surface topography of the area and is influenced by the streams and wetland areas. To aid in understanding regional groundwater flow conditions, a 3-dimensional groundwater flow model (MODFLOW) was developed for the area. A depiction of the modeled area and the calibrated potentiometric surface is presented as Figure 4-8. As indicated on this figure, groundwater north of the site flows southerly towards Sutton Brook or westerly towards the Shawsheen River. Groundwater east of the site, flows westerly or southerly towards Sutton Brook and an un-named tributary. Groundwater south of the site flows northerly towards Sutton Brook or the Shawsheen River. Groundwater west of the Site flows either northerly toward the Shawsheen River or easterly towards Sutton Brook.

Figure 4-9a depicts approximate configurations of the water table surface, based on data collected on April 20, 2005 (high water) compared to those conditions measured on September 19, 2005 (low water). As shown on this figure, groundwater flow patterns during both seasons are similar to regional patterns. Both surveys indicate flow southwesterly towards Sutton Brook on the northern portion of the site and northerly towards the brook on the southern portion of the Site. As shown on the figure, the brook is the main hydrologic feature controlling shallow groundwater flow directions regardless of season.

To further understand groundwater flow, approximate configurations of the intermediate overburden potentiometric surfaces (area of higher groundwater contamination) from the same periods (April 2005 and September 2005) are presented on Figure 4-9b. As shown on this figure, a similar groundwater flow pattern, as observed under water table conditions, was observed in the intermediate overburden with flow towards Sutton Brook.

Additional data was collected in December 2005 and represents mid-point altitudes between the high and low water events. The surveys of the water table surface and the intermediate overburden potentiometric surfaces on this date are presented in Figures 4-10a and 4-10b, respectively. The December 2005 surveys show similar groundwater patterns to those in April 2005 and September 2005. This data further supports the groundwater flow model and regional flow with groundwater flowing easterly towards Sutton Brook from the western residential area. These measurements also support the previous measurements and



regional groundwater flow patterns with a net northerly flow pattern on the northwest portion of the Site in the direction of the stream flow of Sutton Brook.

Due to the changes in water levels, slight changes in the direction of groundwater flow were observed from September 2005 to May 2006, specifically on the northwest portion of the Site near the Former Drum Disposal Area and in the wetland area south of Sutton Brook. Still, under both seasons, flow continued to Sutton Brook and eventually followed the direction of the stream flow of Sutton Brook. There were similar, slight localized changes in the groundwater flow patterns on other areas of the Site from season to season. However, overall, groundwater flow at the Site measured over the seasons remains consistent with the regional groundwater flow patterns.

To aid in determining the relationship between shallow groundwater and the brook/wetland areas, shallow piezometers were installed and water levels were measured inside the piezometer and then compared to surface water levels measured outside the piezometer. A summary of these measurements from May 2006 (high water) and October 2006 (low water) is provided in Table 4-5 below.

Table 4-5 Summary of Water Levels from Stream and Wetland Piezometers

Piezometer	Location	25-May-06		2-Oct-06	
		DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)
WP-1 (01)	Brook	2.70 (in)	77.40	3.20 (in)	76.90
		2.72 (out)	77.38	3.24 (out)	76.86
WP-2 (01)	Brook	1.81 (in)	78.28	1.89 (in)	78.20
		1.84 (out)	78.25	1.97 (out)	77.27
WP-1 (04)	Brook	2.49 (in)	76.79	2.82 (in)	76.46
		2.57 (out)	76.71	2.97 (out)	76.31
WP-2 (04)	Brook	0.78 (in)	78.54	0.96 (in)	78.36
		0.87 (out)	78.45	1.02 (out)	78.30
WP-3 (04)	Brook	1.55 (in)	79.34	1.92 (in)	78.97
		1.76 (out)	79.13	2.92 (out)	77.97
WP-4 (04)	Brook	2.21 (in)	80.79	2.31 (in)	80.69
		2.26 (out)	80.74	2.40 (out)	80.60
WP-5 (04)	Wetland (SL)	2.65 (in)	78.26	2.87 (in)	78.04
		2.83 (out)	78.08	dry (out)	78.01
WP-6 (05)	Wetland (DM)	2.20 (in)	80.92	2.36 (in)	80.76
		2.20 (out)	80.92	2.31 (out)	80.81
WP-7 (05)	Wetland (DM)	1.36 (in)	81.66	1.78 (in)	81.24
		1.75 (out)	81.27	1.87 (out)	81.15
WP-8 (05)	Wetland (FDDA)	2.03 (in)	78.05	2.17 (in)	77.91
		2.20 (out)	77.88	2.27 (out)	77.81
WP-9 (05)	Wetland (FDDA)	2.30 (in)	77.98	2.57 (in)	77.71
		2.38 (out)	77.90	2.47 (out)	77.81
WP-10 (05)	Wetland (SL)	2.12 (in)	78.10	2.32 (in)	77.90
		2.04 (out)	78.18	2.21 (out)	78.01
WP-11 (05)	Wetland	2.50 (in)	79.04	2.61 (in)	78.93
		2.52 (out)	79.02	2.65 (out)	78.89
WP-12 (05)	Tributary	1.76 (in)	78.58	1.95 (in)	78.39
		1.78 (out)	78.56	1.95 (out)	78.39
WP-13 (05)	Tributary	0.78 (in)	78.06	1.48 (in)	77.36
		1.30 (out)	77.54	1.54 (out)	77.30



As indicated on Table 4-5, all water elevations from piezometers installed within the brook or tributary were higher inside the piezometer compared to surface water outside of the piezometer, which is an indication of shallow groundwater discharge to surface water. The piezometers installed in the wetlands indicated variable discharge/recharge conditions between the two seasonal events. A comparison of groundwater potentiometric heads measured in deeper wells screened in the overburden also indicated a groundwater to surface water discharge condition. However, during some events (e.g., high water events) surface water elevations were higher than those measured in the shallow groundwater wells or piezometers. This can be attributed to the flooding of the wetland areas due to increased flow from off-site areas. In addition, the potentiometric data from wells screened throughout the overburden aquifer indicate that not all overburden groundwater discharges to the brook/wetlands in the immediate vicinity of the site (refer to hydrogeologic cross sections presented at the end of this section).

With regard to potential or predominant groundwater flow directions in the bedrock, a fracture trace analyses was conducted in June 1995 to determine the preferred orientation of fractures within exposed bedrock outcrops (M&E, 1996). As part of this analysis, three bedrock outcrops located within a 0.5 mile of the site were used in the analysis.

The results of the analysis indicated a preferred northeast-southwest trending fracture direction with a secondary northwest-southeast trending fracture direction. This data suggests the potential for a southwesterly groundwater flow direction, which is the predominant direction observed in the overburden groundwater on the northern portion of the Site.

Horizontal and vertical gradients were calculated from site data as part of the groundwater flow evaluation. The horizontal gradients were estimated by calculating the head differences between wells that are aligned parallel to the direction of groundwater flow. Vertical gradients were calculated at monitoring well clusters with one well screened across the water table surface (in the overburden) and the other well screened either deeper in the overburden or in bedrock. A summary of the estimated horizontal hydraulic gradients is presented in Table 4-6 (below).

Table 4-6
Summary of Horizontal Hydraulic Gradients

Site Area	Zone	Wells	September 2005 Average Horizontal Gradient (ft/ft)	April 2005 Average Horizontal Gradient (ft/ft)
Northwest portion (Former Drum Disposal Area)	Water Table	MW-12 – MW-7S	0.007	0.006
	Intermediate Overburden	WED-7 – GP-25 MW-8M – GP-23	0.0009	0.0010
Southwest portion	Water Table	MW-19S – MW-21	0.003	0.004
	Intermediate Overburden	MW-19D – MW-21M	0.003	0.004
Upgradient Perkins property	Water Table	B-24 – PMW-6 B-19 – B-22	0.008	0.009



Site Area	Zone	Wells	October 2006 Average Horizontal Gradient (ft/ft)	May 2006 Average Horizontal Gradient (ft/ft)
Residential Area West of Sutton Brook	Water Table	MW-25 – MW-13S	0.0003	0.02
	Intermediate Overburden	MW-25M – MW-13D	0.003	0.006

As indicated above, generally, the horizontal hydraulic gradients were slightly higher at the water table compared to the intermediate overburden. The hydraulic gradients observed on the upgradient Perkins property and residential areas west of the Site were steeper than those observed on the northwestern and southwestern portions of the Site. The flattest hydraulic gradient, regardless of season, was observed in the intermediate overburden aquifer on the northwest portion of the Site, in the area of the Former Drum Disposal Area.

A summary of the estimated vertical hydraulic gradients is presented in Table 4-7. As indicated on this table, the majority of the gradients (61%) indicate an upward flow potential. The overall average vertical gradient at the Site (excluding wells MW-24/24M and MW-25/25M) varies from 0.001 ft/ft in an upward direction during high water conditions to 0.007 ft/ft in an upward direction during low water conditions. The gradient in the area around the Former Drum Disposal Area, including the aquatic wetland south and west of the FDDA, exhibit an average upward flow potential from both the intermediate overburden to shallow water (0.010 ft/ft, varying seasonally) and from bedrock to intermediate overburden (0.001 ft/ft). However, certain exceptions to this include downward flow potential from the intermediate overburden to the bedrock at monitoring wells MW-13D/B (0.003 ft/ft, average) and MW-16D/B (0.006 ft/ft).

Based on a review of the hydraulic gradients, groundwater flow is in a predominantly horizontal direction (horizontal gradients greater than vertical gradients) with an upward flow component under the majority of conditions. This average upward flow pattern is maintained through the seasonal variations measured at the Site.

Eleven single well response tests (3 tests at the water table wells, 3 tests at intermediate screened overburden wells; 1 test in the deep overburden; and 4 tests in bedrock) were conducted across the site to provide an estimate of the hydraulic conductivity of the saturated overburden soils and upper portion of the bedrock at the site. The single well response tests were conducted using the rising and/or falling head method as described in Section 2.

The estimated hydraulic conductivity values calculated from the single well response tests are presented in Table 4-8. A summary of the estimated hydraulic conductivity for each of the geologic units tested are as follows.

Summary of Estimated Hydraulic Conductivity

Hydrogeologic Unit	Number of Tests	Range (ft/day)	Average	
			(ft/day)	(cm/sec)
Water table sands and gravel	3	2.3 – 58	26.5	9.36×10^{-3}
Intermediate sand and silt	3	0.9 – 6.1	2.9	1.02×10^{-3}
Deeper overburden sand	1	11 – 12.8	11.9	4.20×10^{-3}
Bedrock	4	0.01 – 3.2	0.7	2.45×10^{-4}

Notes: ft/day = feet per day; cm/sec = centimeters/second



A comparison of the average values for each of the hydrogeologic units indicates the estimated hydraulic conductivity generally decreases with depth in the overburden with the exception of the deeper coarser sand layer, where encountered. These values are also consistent with published ranges for the types of geologic materials encountered as well as other studies completed within the area.

As shown on Figure 4-11, the USGS has mapped transmissivities in this area of 1,400 to 4,000 square feet per day. The Town of Tewksbury has estimated a transmissivity for the former well field at 2,900 square feet per day (CDM, 1986). Assuming an average aquifer thickness at the site of 50 feet, an estimated hydraulic conductivity would be in the range of 30 to 60 feet per day.

The average lateral seepage velocity for groundwater can be approximated from site-specific data using the following equation:

$$V = Ki/n_e$$

Where

V = average lateral seepage velocity

K = hydraulic conductivity

n_e = effective porosity

i = horizontal hydraulic gradient

Using the horizontal hydraulic gradients presented above, an average value for K, and estimated value for n_e (22% for non-uniform sand to gravelly sand – Kresic, 1997) for the two overburden flow zones (water table and intermediate overburden), the estimated seepage velocity is presented below.

- Water table conditions – 0.36 to 1.1 feet per day or 130 to 400 feet per year
- Intermediate overburden – 0.01 to 0.04 feet per day or 4 to 14 feet per year

The calculated groundwater velocities represent the estimated flow rate between various monitoring wells located on the site and specific geologic units, and not the entire aquifer. Average lateral seepage velocities do not represent the velocity of water particles traveling through pore spaces or fractures, which generally would be larger because groundwater travels along irregular paths, between soil particles.

In addition, the estimated groundwater flow velocities are not necessarily indicative of the rate of contaminant transport. The flow rate should be considered an approximation for the movement of groundwater. Factors that cause dissolved compounds to move more slowly than groundwater include biological and chemical degradation (e.g., chemical transformation or breakdown), precipitation reactions (e.g., dissolved chemical precipitating out of solution as relatively insoluble compounds), and sorption of dissolved chemicals to soil. Depending on the specific properties of the dissolved chemicals and the soil properties each of these reactions will tend to retard (e.g., slow) the migration of dissolved chemicals in the groundwater.

4.4 CLIMATOLOGICAL CONDITIONS

Climatological data for the 55-year period from 1948 through 2003 was obtained from a U.S. Department of Commerce Weather Bureau's weather station, located in Lowell, Massachusetts approximately 7.5 miles from the site.

The measured total annual precipitation ranged from 21.8 inches in 1988 to 60.4 inches in 1983. The annual precipitation average is estimated to be approximately 40.8 inches per year. Monthly precipitation averaged approximately 3.5 inches per month for the 55-year period. The mean monthly temperatures over this time period ranged from 25.7° F in January to 73° F in July.

Based on the above, the Site has a relatively humid and temperate climate with generally cool temperatures.

Table 4-2
Sutton Brook Stream Gauging Locations and Observed Stream Flow
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

SG Location	Description	November-04		September-05		December-05		February-06		June-06		October-06	
		Estimated Flow (cfs)	Estimated Flow (gpm)	Estimated Flow (cfs)	Estimated Flow (gpm)	Estimated Flow (cfs)	Estimated Flow (gpm)	Estimated Flow (cfs)	Estimated Flow (gpm)	Estimated Flow (cfs)	Estimated Flow (gpm)	Estimated Flow (cfs)	Estimated Flow (gpm)
Sutton Brook													
SG-F	Culvert at former RR bed (entering the Site) WP-4(04)	1.06	475.8	0	0	1.94	870.7	0.99	444.3	5.08	2281.5	1.20	540.7
SG-A	Crossing at Landfill	1.34	601.4	0.15	67.3	3.04	1364.5	1.15	516.1	7.98	3582.4	1.39	621.8
SG-B	Wetland at WP-2(04) (non-channelized flow)	1.53	686.7	2.22	996.4	1.88	843.8	0.98	439.8	5.29	2372.4	1.11	497.5
SG-E	Outlet at South St	2.5	1,122.10	0.15	67.3	4.59	2060.2	2.81	1261.1	16.02	7191.9	2.32	1040.5
Tributaries													
SG-G	Tributary from Southwest	0.55	246.9	-0.07	-31.4	1.14	511.7	0.69	309.7	3.08	1383.9	0.37	166.8
SG-H	Tributary from Southeast	0.36	161.5	0	0	0.58	260.3	0.25	112.2	5.66	2541.7	0.02	9.5
SG-I	Tributary from North at former RR bed	0.1	44.9	0	0	0.21	94.3	0.09	40.4	0.80	359.0	0.45	199.9
SG-D	Tributary from north at MW-1S/1R	0.14	62.8	0	0	0.24	107.7	-0.02	-9.0	0.25	110.2	0.03	11.2
Notes:													
1. "December 2006" stream gauging was completed on January 10, 2006; and "February 2006" stream gauging was completed on March 1, 2006.													
2. Measurements were made using a Vernier scale wading rod, calibrated to use the 6/10 depth method to gauge stream velocity. Flow is calculated based on the cross-sectional area of the stream in each location.													
3. Due to inaccuracies measuring low flows in September 2005, the particular data presented above for that date was not used in the Site hydrologic models. However, based on site observations, the tributaries measured at SG-D, SG-F, SG-H, and SG-I were all dry, and not contributing to the brook during this low water event.													
SG = Stream Gauging, cfs = cubic feet per second, gpm = gallons per minute													

Table 4-3
Summary of Groundwater Elevations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Well Identification	Ground Surface Elev (ft NAD 88)	Well Screen Information		Groundwater Levels														
		Depth (ft)	Elevation (ft NAD 88)	Top of PVC Elev (ft NAD 88)	16-Dec-04		20-Apr-05		19-Sep-05		12-Dec-05		21-Feb-06		25-May-06		2-Oct-06	
					DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)
Water table wells																		
MW-1S	79.1	2-11	77.1 - 68.1	81.79	4.16	77.63	4.57	77.22	5.26	76.53	4.64	77.15	4.57	77.22	4.38	77.41	4.89	76.90
MW-2S	82.6	5-15	77.6 - 67.6	84.68	5.35	79.33	5.17	79.51	6.16	78.52	5.47	79.21	5.23	79.45	5.03	79.65	5.69	78.99
MW-3S	83.8	9-19	74.8 - 64.8	85.98	6.02	79.96	NM	-	6.99	78.99	5.85	80.13	5.53	80.45	5.32	80.66	6.49	79.49
MW-6	82.6	5-15	77.6 - 67.6	85.09	6.03	79.06	5.83	79.26	6.73	78.36	6.02	79.07	5.86	79.23	5.77	79.32	6.39	78.70
MW-7S	79.9	0-10	79.9 - 69.9	82.69	4.52	78.17	4.33	78.36	5.92	76.77	4.60	78.09	4.73	77.96	4.48	78.21	5.00	77.69
MW-11S	77.7	4-14	73.7 - 63.7	79.82	2.15	77.67	1.34	78.48	2.32	77.50	2.18	77.64	2.20	77.62	2.06	77.76	2.26	77.56
MW-12	83.6	4-14	79.6 - 69.6	86.97	7.71	79.26	7.45	79.52	8.85	78.12	7.85	79.12	4.44	82.53	6.93	80.04	8.33	78.64
MW-13S	78.3	5-15	73.3 - 63.3	80.67	2.85	77.82	2.69	77.98	3.53	77.14	3.08	77.59	3.10	77.57	2.85	77.82	3.27	77.40
DEP-1	78.7	Not Available		80.98	3.90	77.08	3.33	77.65	NM	--	4.01	76.97	1.60 (ice)	79.38	3.81	77.17	NM	NM
MW-17S	80.6	5-15	75.6 - 65.6	83.2	5.28	77.92	4.42	78.78	5.40	77.80	5.32	77.88	5.30	77.90	5.13	78.07	5.31	77.89
MW-19S	88.2	10-20	78.2 - 68.2	91.06	6.92	84.14	7.04	84.02	9.47	81.59	7.27	83.79	7.01	84.05	6.19	84.87	8.40	82.66
MW-21	78.9	1-11	77.9 - 67.9	81.53	3.31	78.22	2.96	78.57	4.01	77.52	3.26	78.27	2.90 (ice)	78.63	3.20	78.33	3.46	78.07
MW-24	86.4	3-13	83.4 - 73.4	86.11	Not Installed		Not Installed		Not Installed		6.78	79.33	6.44	79.67	4.85	81.26	7.89	78.22
MW-25	95.2	10-20	85.2 - 75.2	94.83	Not Installed		Not Installed		Not Installed		13.77	81.06	10.50	84.33	7.52	87.31	17.30	77.53
WES-01	84.5	Not Available		86.72	3.20	83.52	2.91	83.81	7.56	79.16	3.24	83.48	2.77	83.95	2.73	83.99	4.87	81.85
WES-04	85	Not Available		87.32	4.59	82.73	4.54	82.78	6.07	81.25	4.73	82.59	4.59	82.73	4.31	83.01	5.08	82.24
WES-06	89.7	Not Available		92.34	12.11	80.23	11.91	80.43	13.51	78.83	12.33	80.01	11.96	80.38	11.05	81.29	12.9	79.44
GP-1	82.3	2-12	80.3 - 70.3	84.14	3.22	80.92	3.05	81.09	4.74	79.40	Not Found		3.19	80.95	2.89	81.25	4.08	80.06
GP-2	82.0	2-12	80 - 70	84.97	4.92	80.05	4.48	80.49	5.78	79.19	4.83	80.14	4.44	80.53	4.34	80.63	5.23	79.74
GP-3	84.4	2-12	82.4 - 72.4	86.84	7.78	79.06	7.27	79.57	8.45	78.39	7.99	78.85	7.49	79.35	7.06	79.78	8.09	78.75
GP-4	84.4	3.5-13.5	80.9 - 70.9	85.74	4.90	80.84	3.42	82.32	7.32	78.42	5.07	80.67	3.39	82.35	2.95	82.79	6.98	78.76
GP-5	88.4	8-18	80.4 - 70.4	90.45	11.40	79.05	10.81	79.64	12.21	78.24	11.20	79.25	10.94	79.51	10.60	79.85	11.88	78.57
GP-6	85.4	8-18	77.4 - 67.4	87.52	8.47	79.05	8.14	79.38	9.09	78.43	8.40	79.12	8.22	79.30	8.05	79.47	8.74	78.78
GP-9	83.0	10-20	73 - 63	86.96	4.59	82.37	4.42	82.54	6.10	80.86	4.86	82.10	4.45	82.51	4.22	82.74	5.18	81.78
GP-10	83.6	8-18	75.6 - 65.6	86.94	6.28	80.66	6.09	80.85	7.52	79.42	4.75	82.19	6.31	80.63	6.02	80.92	6.88	80.06
GP-11	83.7	7-17	76.7 - 66.7	86.79	6.13	80.66	5.78	81.01	7.68	79.11	6.18	80.61	5.99	80.8	5.71	81.08	6.82	79.97
GP-12	82.2	3-13	79.2 - 69.2	84.76	4.77	79.99	4.40	80.36	6.04	78.72	4.75	80.01	4.67	80.09	4.54	80.22	5.52	79.24
GP-13	84.2	5-15	79.2 - 69.2	86.70	7.35	79.35	6.79	79.91	8.50	78.20	7.09	79.61	7.05	79.65	7.01	79.69	8.15	78.55
GP-14	82.6	3-13	79.6 - 69.6	84.54	5.11	79.43	4.75	79.79	6.75	77.79	5.55	78.99	5.36	79.18	4.74	79.80	6.69	77.85
GP-15	83.6	6-16	77.6 - 67.6	86.8	7.25	79.55	6.71	80.09	9.22	77.58	6.85	79.95	6.83	79.97	6.55	80.25	8.59	78.21
GP-16	81.0	10 - 20	71 - 61	83.28	3.96	79.32	3.61	79.67	5.92	77.36	4.31	78.97	4.38	78.90	4.34	78.94	5.37	77.91
GP-19	84.2	3-13	81.2 - 71.2	86.08	4.08	82.00	4.11	81.97	5.75	80.33	4.20	81.88	4.08	82.00	4.03	82.05	4.55	81.53
GP-26	80.9	2-12	78.9 - 68.9	81.44	1.00	80.44	0.84	80.60	2.21	79.23	Not Found		1.11	80.33	0.81	80.63	1.50	79.94
PMW-1	91.7	4-14	87.7 - 77.7	94.85	8.55	86.30	7.25	87.60	12.22	82.63	8.41	86.44	7.07	87.78	6.57	88.28	11.28	83.57
PMW-2	94.5	4-14	90.5 - 80.5	98.01	10.67	87.34	9.61	88.40	14.52	83.49	10.20	87.81	9.68	88.33	9.35	88.66	13.49	84.52
PMW-3	89.9	4-14	85.9 - 75.9	92.52	9.34	83.18	8.66	83.86	11.83	80.69	9.35	83.17	8.72	83.80	8.40	84.12	10.94	81.58
PMW-4	88.4	2-10	86.4 - 76.4	90.60	4.87	85.73	3.65	86.95	8.00	82.60	4.55	86.05	3.60	87.00	3.32	87.28	6.99	83.61
PMW-5	88.1	2-10	86.1 - 76.1	91.24	5.14	86.10	3.85	87.39	8.54	82.70	4.93	86.31	3.39	87.85	2.91	88.33	7.26	83.98
PMW-6	89.8	2-10	87.8 - 77.8	92.76	7.78	84.98	6.97	85.79	11.27	81.49	7.93	84.83	6.87	85.89	5.84	86.92	10.21	82.55

Table 4-3
Summary of Groundwater Elevations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Well Identification	Ground Surface Elev (ft NAD 88)	Well Screen Information		Groundwater Levels														
		Depth (ft)	Elevation (ft NAD 88)	Top of PVC Elev (ft NAD 88)	16-Dec-04		20-Apr-05		19-Sep-05		12-Dec-05		21-Feb-06		25-May-06		2-Oct-06	
					DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)
Intermediate Overburden Wells																		
MW-4S	81.4	15-25	66.4 - 56.4	83.66	4.78	78.88	4.11	79.55	6.21	77.45	4.70	78.96	4.37	79.29	4.18	79.48	5.45	78.21
MW-5	81.9	15-25	66.9 - 56.9	84.62	4.53	80.09	3.66	80.96	6.22	78.40	4.13	80.49	3.95	80.67	3.72	80.90	5.84	78.78
MW-7M	78.6	15-25	63.6 - 53.6	82.46	3.93	78.53	3.62	78.84	4.99	77.47	4.11	78.35	3.93	78.53	3.57	78.89	4.48	77.98
MW-8M	78.1	20-30	58.1 - 48.1	80.96	3.16	77.80	2.43	78.53	3.50	77.46	3.23	77.73	3.18	77.78	3.11	77.85	2.99	77.97
MW-9	77	15-25	62 - 52	79.73	1.69	78.04	1.16	78.57	2.44	77.29	1.84	77.89	1.78	77.95	1.65	78.08	1.95	77.78
MW-10	79.1	15-25	64.1 - 54.1	81.79	4.02	77.77	3.25	78.54	4.43	77.36	3.87	77.92	3.90	77.89	3.71	78.08	3.91	77.88
MW-11	77.3	27-37	50.3 - 40.3	80.77	3.06	77.71	2.25	78.52	3.30	77.47	3.12	77.65	3.07	77.70	2.99	77.78	3.05	77.72
MW-11D	77.8	53-63	24.8 - 14.8	80.23	2.42	77.81	1.64	78.59	2.66	77.57	2.46	77.77	2.46	77.77	2.29	77.94	2.48	77.75
MW-13D	78	24-34	54 - 44	80.94	3.06	77.88	2.79	78.15	3.67	77.27	3.27	77.67	3.29	77.65	3.00	77.94	3.44	77.50
MW-14	78.3	38-48	40.3 - 30.3	81.21	3.30	77.91	2.57	78.64	3.51	77.70	3.37	77.84	3.41	77.80	3.15	78.06	3.36	77.85
MW-15	83.5	18-28	65.5 - 55.5	86.27	4.52	81.75	4.63	81.64	6.61	79.66	4.51	81.76	4.54	81.73	4.55	81.72	5.10	81.17
MW-16D	76.5	28-38	48.5 - 38.5	79.85	1.81	78.04	1.28	78.57	2.28	77.57	1.91	77.94	1.56 (ice)	78.29	1.61	78.24	2.07	77.78
MW-17D	80.3	40-50	40.3 - 30.3	82.63	4.65	77.98	3.86	78.77	4.85	77.78	4.69	77.94	4.68	77.95	4.48	78.15	4.69	77.94
MW-18D	83.8	49-59	34.8 - 24.8	86.56	7.05	79.51	6.88	79.68	8.72	77.84	7.12	79.44	7.07	79.49	6.90	79.66	7.71	78.85
MW-19D	89.1	34-44	55.1 - 45.1	91.44	7.04	84.40	6.94	84.50	9.43	82.01	7.20	84.24	6.92	84.52	6.59	84.85	8.18	83.26
WED-02	84.1	Not Available		86.3	3.61	82.69	3.14	83.16	5.54	80.76	3.57	82.73	3.15	83.15	2.88	83.42	4.55	81.75
WED-05	85.1	Not Available		87.42	4.71	82.71	4.60	82.82	6.20	81.22	4.85	82.57	5.65	81.77	4.47	82.95	5.24	82.18
WED-07	89.9	Not Available		92.02	11.94	80.08	11.79	80.23	13.22	78.80	12.17	79.85	11.85	80.17	11.25	80.77	12.61	79.41
GP-7	79.1	16 - 26	63.1 - 53.1	82.15	3.71	78.44	3.28	78.87	4.44	77.71	3.90	78.25	3.67	78.48	3.44	78.71	4.15	78.00
GP-8	78.9	20 - 30	58.9 - 48.9	81.54	3.63	77.91	2.92	78.62	3.89	77.65	3.77	77.77	3.78	77.76	3.55	77.99	3.80	77.74
GP-18	83.3	19 - 24	64.3 - 59.3	86.24	6.32	79.92	6.33	79.91	8.32	77.92	NM	NM	NM	NM	6.27	79.97	6.93	79.31
GP-20	79.4	15 - 25	64.4 - 54.4	82.62	3.60	79.02	3.56	79.06	5.08	77.54	3.70	78.92	3.70	78.92	3.68	78.94	4.14	78.48
GP-21	79.5	16 - 26	63.5 - 53.5	83.29	4.61	78.68	4.22	79.07	5.49	77.80	4.71	78.58	4.42	78.87	4.57	78.72	4.90	78.39
MW-21M	78.8	15 - 25	63.8 - 53.8	81.66	3.45	78.21	3.10	78.56	4.15	77.51	3.48	78.18	3.56	78.10	3.45	78.21	3.69	77.97
MW-22M	78.4	26 - 36	52.4 - 42.4	81.38	Not Installed		2.57	78.81	3.64	77.74	3.23	78.15	3.23	78.15	3.11	78.27	3.36	78.02
MW-24M	86.5	19.5 - 29.5	67 - 57	86.09	Not Installed		Not Installed		Not Installed		7.88	78.21	7.70	78.39	7.00	79.09	8.18	77.91
MW-25M	95.3	23 - 33	72.3 - 62.3	95.13	Not Installed		Not Installed		Not Installed		16.21	78.92	15.68	79.45	14.70	80.43	16.45	78.68
GP-23	78.6	15 - 25	63.6 - 53.6	81.42	3.47	77.95	2.79	78.63	3.90	77.52	3.58	77.84	3.69	77.73	3.40	78.02	3.70	77.72
GP-24	77.9	18 - 28	59.9 - 49.9	80.23	2.57	77.66	2.64	77.59	3.33	76.90	2.84	77.39	2.92	77.31	2.75	77.48	3.10	77.13
GP-25	79.3	15 - 25	64.3 - 54.3	82.78	4.69	78.09	4.39	78.39	5.30	77.48	4.81	77.97	4.84	77.94	4.60	78.18	5.01	77.77

Table 4-3
Summary of Groundwater Elevations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Well Identification	Ground Surface Elev (ft NAD 88)	Well Screen Information			Groundwater Levels													
		Depth (ft)	Elevation (ft NAD 88)	Top of PVC Elev (ft NAD 88)	16-Dec-04		20-Apr-05		19-Sep-05		12-Dec-05		21-Feb-06		25-May-06		2-Oct-06	
					DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)
Bedrock																		
MW-1R	78.9	20-30	58.9 - 48.9	81.65	3.99	77.66	4.49	77.16	5.21	76.44	4.65	77.00	4.58	77.07	4.38	77.27	4.93	76.72
MW-2B	82.5	23-37	59.5 - 45.5	84.96	5.34	79.62	5.57	79.39	6.24	78.72	5.48	79.48	5.21	79.75	5.02	79.94	5.80	79.16
MW-3B	83.9	38-51.5	45.9 - 32.4	85.6	5.50	80.10	4.83	80.77	6.47	79.13	5.16	80.44	4.90	80.70	4.69	80.91	5.98	79.62
MW-4B	81.4	34-44	47.4 - 37.4	83.54	4.94	78.60	4.17	79.37	6.05	77.49	4.85	78.69	4.55	78.99	4.37	79.17	5.29	78.25
MW-7R	79.7	37-47	42.7 - 32.7	81.41	2.82	78.59	2.49	78.92	3.58	77.83	2.87	78.54	2.87	78.54	2.65	78.76	3.25	78.16
MW-8R	77.9	67-77	10.9 - 0.9	80.86	2.61	78.25	2.25	78.61	3.44	77.42	2.84	78.02	2.80	78.06	2.66	78.20	2.97	77.89
MW-13B	78.4	43.5-53.5	34.9 - 24.9	80.14	2.38	77.76	2.00	78.14	3.08	77.06	2.47	77.67	2.56	77.58	2.06	78.08	2.71	77.43
MW-16B	77.2	50-60	27.2 - 17.2	80.03	2.06	77.97	1.60	78.43	2.55	77.48	2.15	77.88	2.12	77.91	1.82	78.21	2.35	77.68
MW-17B	80.5	64-74	16.5 - 6.5	82.6	4.36	78.24	3.81	78.79	4.79	77.81	4.43	78.17	4.45	78.15	4.64	77.96	4.55	78.05
MW-18B	83.7	67-77	16.8 - 6.8	86.34	7.03	79.31	6.74	79.60	8.45	77.89	7.09	79.25	7.07	79.27	6.90	79.44	7.65	78.69
MW-19B	88.7	59-69	29.7 - 19.7	91.29	6.06	85.23	5.88	85.41	8.68	82.61	6.28	85.01	5.91	85.38	5.58	85.71	7.36	83.93
MW-22B	78.4	56-66	22.4 - 12.4	81.39	Not Installed		2.42	77.83	3.37	78.02	2.63	78.76	2.89	78.5	2.39	79.00	2.93	78.46
MW-23B	89.9	48-58	40.9 - 30.9	92.73	8.64	84.09	8.03	84.70	10.64	82.09	8.47	84.26	8.01	84.72	7.72	85.01	9.57	83.16
WEB-03	84.3	Not Available		85.99	3.32	82.67	2.80	83.19	5.11	80.88	3.20	82.79	2.83	83.16	2.56	83.43	4.16	81.83
PSI Wells (Perkins Property)																		
B-2-OW	95.0	3 - 13	92 - 82	97.46	6.13	91.33	5.59	91.87	9.62	87.84	6.30	91.16	5.40	92.06	4.45	93.01	8.48	88.98
B-15-OW	90.4	3 - 13	87.4 - 77.4	92.71	4.45	88.26	3.75	88.96	7.77	84.94	4.71	88.00	3.47	89.24	3.06	89.65	6.77	85.94
B-16-OW	90.9	3 - 13	87.9 - 77.9	93.06	4.08	88.98	3.90	89.16	8.16	84.90	4.43	88.63	3.64	89.42	3.34	89.72	6.82	86.24
B-17-OW	93.8	Not Found		96.30	Not Found		Not Found		Not Found		Not Found		Not Found		Not Found		Not Found	
B-19-OW	96.3	10 - 20	86.3 - 76.3	99.13	8.91	90.22	7.17	91.96	12.01	87.12	8.68	90.45	7.30	91.83	6.10	93.03	10.84	88.29
B-22-OW	88.9	10 - 20	78.9 - 68.9	91.70	4.66	87.04	4.10	87.60	7.91	83.79	5.33	86.37	4.88	86.82	4.47	87.23	6.48	85.22
B-24-OW	95.2	10 - 20	85.2 - 75.2	97.98	7.04	90.94	4.97	93.01	9.42	88.56	6.87	91.11	5.15	92.83	3.89	94.09	8.51	89.47
Town WellField Wells																		
T1 (1 1/2 diam)	83.9	53-63	30.9 - 20.9	84.89	2.06	82.83	1.58	83.31	3.99	80.90	2.00	82.89	1.46	83.43	0.82	84.07	2.85	82.04
T1 (3/4" diam)	83.9	18-23	65.9 - 60.9	85.08	2.52	82.56	1.76	83.32	4.41	80.67	2.61	82.47	1.95	83.13	1.25	83.83	3.27	81.81
T2 (1 1/2" diam)	82.8	39-49	43.8 - 33.8	83.74	3.19	80.55	3.04	80.70	3.87	79.87	2.35	81.39	3.09	80.65	2.77	80.97	3.37	80.37
T2 (3/4" diam)	82.8	8-13	74.8 - 69.8	83.86	3.30	80.56	3.20	80.66	3.80	80.06	2.30	81.56	3.23	80.63	3.02	80.84	3.38	80.48
T4 (1 1/2"diam)	80.1	24.5-34.5	55.6 - 45.6	81.33	1.58	79.75	1.32	80.01	2.11	79.22	1.50	79.83	1.36	79.97	1.15	80.18	1.50	79.83
T4 (3/4 " diam)	80.1	7.5 - 12.5	72.6 - 67.6	80.83	1.74	79.09	1.51	79.32	2.14	78.69	1.61	79.22	1.53	79.30	1.39	79.44	1.56	79.27
T5	78.3	35-45	43.3 - 33.3	81.28	2.41	78.87	2.26	79.02	3.30	77.98	2.50	78.78	2.32	78.96	2.14	79.14	2.48	78.80
T6	79.8	35-45	44.8 - 34.8	81.41	2.96	78.45	2.69	78.72	3.87	77.54	2.93	78.48	2.91	78.50	2.74	78.67	3.08	78.33
Krochmal Farm wells																		
KFMW-11	92.3	4-14	88.3 - 78.3	94.83	8.05	86.78	6.68	88.15	10.54	84.29	8.08	86.75	7.02	87.81	5.65	89.18	9.71	85.12
KFMW-12	88.3	2-12	86.3 - 76.3	90.23	5.82	84.41	5.11	85.12	8.20	82.03	6.80	83.43	5.05	85.18	4.78	85.45	Destroyed	
KFMW-15	93.8	2-12	91.8 - 81.8	96.56	8.83	87.73	8.35	88.21	12.04	84.52	9.08	87.48	8.50	88.06	7.32	89.24	10.73	85.83

Table 4-3
Summary of Groundwater Elevations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Well Identification	Ground Surface Elev (ft NAD 88)	Well Screen Information		Groundwater Levels														
		Depth (ft)	Elevation (ft NAD 88)	Top of PVC Elev (ft NAD 88)	16-Dec-04		20-Apr-05		19-Sep-05		12-Dec-05		21-Feb-06		25-May-06		2-Oct-06	
					DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)	DTW (ft bPVC)	Elev (ft NAD 88)
Stream and Wetland Piezometers																		
WP-1(01)		0.5 - 2.5		80.10	2.44	77.66	2.70 (in)	77.40	3.62 (in)	76.48	2.81 (in)	77.29	2.91 (in)	77.19	2.70 (in)	77.40	3.20 (in)	76.90
					NM	--	2.90 (out)	77.20	NM	--	2.82 (out)	77.28	2.91 (out)	77.19	2.72 (out)	77.38	3.24 (out)	76.86
WP-2 (01)		0.5 - 2.5		80.09	2.01	78.08	NM	--	1.91 (in)	78.18	1.91 (in)	78.18	NM	--	1.81 (in)	78.28	1.89 (in)	78.20
					NM	--	NM	--	NM	--	1.98 (out)	78.11	NM	--	1.84 (out)	78.25	1.97 (out)	77.27
WP-1(04)	75.3	1 - 3	74.3 - 72.3	79.28	1.67	77.61	2.55 (in)	76.73	3.25 (in)	76.03	2.62 (in)	76.66	2.50 (ice)	76.78	2.49 (in)	76.79	2.82 (in)	76.46
					NM	--	2.62 (out)	76.66	NM	--	2.70 (out)	76.58	NM	--	2.57 (out)	76.71	2.97 (out)	76.31
WP-2 (04)	75.2	1 - 3	74.3 - 72.3	79.32	1.11	78.21	0.09 (in)	79.23	0.98 (in)	78.34	1.02 (in)	78.30	1.35 (in)	77.97	0.78 (in)	78.54	0.96 (in)	78.36
					NM	--	0.12 (out)	79.20	NM	--	1.06 (out)	78.26	0.97 (out)	78.35	0.87 (out)	78.45	1.02 (out)	78.30
WP-3 (04)	75.8	0 - 2	75.9 - 73.9	80.89	1.86	79.03	0.98 (in)	79.91	1.95 (in)	78.94	1.82 (in)	79.07	1.30 (in)	79.59	1.55 (in)	79.34	1.92 (in)	78.97
					NM	--	1.13 (out)	79.76	NM	--	2.00 (out)	78.89	1.96 (out)	78.93	1.76 (out)	79.13	2.92 (out)	77.97
WP-4 (04)	78.7	1 - 3	78.0 - 76.0	83.00	2.16	80.84	2.03 (in)	80.97	2.62 (in)	80.38	1.98 (in)	81.02	2.04 (in)	80.96	2.21 (in)	80.79	2.31 (in)	80.69
					NM	--	2.07 (out)	80.93	NM	--	2.04 (out)	80.96	2.25 (out)	80.75	2.26 (out)	80.74	2.40 (out)	80.60
WP-5 (04)	77.2	1.5 - 3.5	75.9 - 73.9	80.91	2.73 (ice)	78.18	2.06 (in)	78.85	3.09 (in)	77.82	2.72 (in)	78.19	2.60 (ice)	78.31	2.65 (in)	78.26	2.87 (in)	78.04
					NM	--	2.15 (out)	78.76	NM	--	2.70 (out)	78.21	NM	--	2.83 (out)	78.08	dry (out)	78.01
WP-6	80.9	3 - 5	78.1 - 76.1	83.12	Not Installed		Not Installed		Not Installed		2.24 (in)	80.88	2.16 (in)	80.96	2.20 (in)	80.92	2.36 (in)	80.76
											2.13 (out)	80.99	2.12 (out)	81.00	2.20 (out)	80.92	2.31 (out)	80.81
WP-7	81.4	8 - 10	73.0 - 71.0	83.02	Not Installed		Not Installed		Not Installed		1.52 (in)	81.50	1.63 (in)	81.39	1.36 (in)	81.66	1.78 (in)	81.24
											1.74 (out)	81.28	1.63 (out)	81.39	1.75 (out)	81.27	1.87 (out)	81.15
WP-8	77.8	3 - 5	75.1 - 73.1	80.08	Not Installed		Not Installed		Not Installed		2.20 (in)	77.88	2.22 (in)	77.86	2.03 (in)	78.05	2.17 (in)	77.91
											2.19 (out)	77.89	2.18 (out)	77.90	2.20 (out)	77.88	2.27 (out)	77.81
WP-9	77.8	2.5 - 4.5	75.3 - 73.3	80.28	Not Installed		Not Installed		Not Installed		2.46 (in)	77.82	2.48 (in)	77.80	2.30 (in)	77.98	2.57 (in)	77.71
											2.52 (out)	77.76	2.34 (out)	77.94	2.38 (out)	77.90	2.47 (out)	77.81
WP-10	78.3	3 - 5	75.2 - 73.2	80.22	Not Installed		Not Installed		Not Installed		2.23 (in)	77.99	2.24 (in)	77.98	2.12 (in)	78.10	2.32 (in)	77.90
											2.06 (out)	78.16	NM	--	2.04 (out)	78.18	2.21 (out)	78.01
WP-11	78.7	2 - 4	76.5 - 74.5	81.54	Not Installed		Not Installed		Not Installed		2.70 (in)	78.84	2.65 (in)	78.89	2.50 (in)	79.04	2.61 (in)	78.93
											NM	--	2.52 (out)	79.02	2.52 (out)	79.02	2.65 (out)	78.89
WP-12	78.4	3 - 5	75.3 - 73.3	80.34	Not Installed		Not Installed		Not Installed		1.92 (in)	78.42	2.02 (in)	78.32	1.76 (in)	78.58	1.95 (in)	78.39
											NM	--	2.03 (out)	78.31	1.78 (out)	78.56	1.95 (out)	78.39
WP-13	77.5	9 - 11	68.8 - 66.8	78.84	Not Installed		Not Installed		Not Installed		1.68 (in)	77.16	1.29 (in)	77.55	0.78 (in)	78.06	1.48 (in)	77.36
											1.30 (out)	77.54	1.45 (out)	77.39	1.30 (out)	77.54	1.54 (out)	77.30
SW1-99	Piezometer destroyed				Destroyed		Destroyed		Destroyed		Destroyed		Destroyed		Destroyed		Destroyed	
SW2-99	Piezometer destroyed				Destroyed		Destroyed		Destroyed		Destroyed		Destroyed		Destroyed		Destroyed	
SW3-99		Not Available		78.37	NM	--	NM	-	NM	--	NM	--	0.30 (in)	78.07	0.33 (in)	78.04	NM	NM
					0.56	77.81	NM	--	NM	--	0.57 (out)	77.80	0.30 (out)	78.07	0.25 (out)	78.12		
SW4-99		Not Available		79.53	1.10	78.43	NM	-	NM	--	NM	--	NM	--	NM	NM	NM	NM
					NM	--	NM	--	NM	--	1 (out)	78.53	NM	--	0.94 (out)	78.59		

NOTES:

ft = feet below ground surface

PVC = polyvinyl chloride

NAD 88 = North American Datum of 1988

DTW = Depth to water

Stream and Wetland Piezometer's elevation references top of steel casing, depth references below stream bottom, and ground surface references top of stream bottom.

Table 4-7

**Summary of Vertical Hydraulic Gradients
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Monitoring Well Identifier	Vertical Distance Between Well Screens ¹ (ft)	Geologic Unit	Dec2004 Groundwater Altitude (ft)	Gradient (ft/ft)	Apr2005 Groundwater Altitude (ft)	Gradient (ft/ft)	Sep2005 Groundwater Altitude (ft)	Gradient (ft/ft)	Dec2005 Groundwater Altitude (ft)	Gradient (ft/ft)	Feb2006 Groundwater Altitude (ft)	Gradient (ft/ft)	May2006 Groundwater Altitude (ft)	Gradient (ft/ft)	Oct2006 Groundwater Altitude (ft)	Gradient (ft/ft)
MW-2S		Sand	79.33		79.51		78.52		79.21		79.45		79.65		78.99	
MW-2B	20	Bedrock	79.62	-0.015	79.39	0.006	78.72	-0.011	79.48	-0.014	79.75	-0.015	79.94	-0.014	79.16	-0.009
MW-1S		Sand	77.63		77.22		76.53		77.15		77.22		77.41		76.90	
MW-1R	18	Bedrock	77.66	-0.002	77.16	0.003	76.44	0.005	77.00	0.008	77.07	0.008	77.27	0.008	76.72	0.010
MW-3S		Sand	79.96		NM		78.99		80.13		80.45		80.66		79.49	
MW-3B	34	Bedrock	80.10	-0.004	80.77	NA	79.13	-0.004	80.44	-0.009	80.70	-0.007	80.91	-0.007	79.62	-0.004
MW-7S		Sand	78.17		78.36		76.77		78.09		77.96		78.21		77.69	
MW-7M	14	Sand & Silt	78.53	-0.025	78.84	-0.033	77.47	-0.053	78.35	-0.018	78.53	-0.040	78.89	-0.047	77.98	-0.021
MW-7M		Sand & Silt	78.53		78.84		77.47		78.35		78.53		78.89		77.98	
MW-7R	21	Bedrock	78.59	-0.003	78.92	-0.004	77.83	-0.017	78.54	-0.009	78.54	0.000	78.76	0.006	78.16	-0.009
MW-8M		Sand & Silt	77.80		78.53		77.46		77.73		77.78		77.85		77.97	
MW-8R	47	Bedrock	78.25	-0.010	78.61	-0.002	77.42	0.001	78.02	-0.006	78.06	-0.006	78.20	-0.007	77.89	0.002
MW-11S		Sand	77.67		78.48		77.50		77.64		77.62		77.76		77.56	
MW-11	27	Sand & Silt	77.71	-0.001	78.52	-0.001	77.47	0.001	77.65	0.000	77.70	-0.003	77.78	-0.001	77.72	-0.006
MW-11		Sand & Silt	77.71		78.52		77.47		77.65		77.70		77.78		77.72	
MW-11D	26	Deep	77.81	-0.004	78.59	-0.003	77.57	-0.004	77.77	-0.005	77.77	-0.003	77.94	-0.006	77.75	-0.001
MW-13S		Sand	77.82		77.98		77.14		77.59		77.57		77.82		77.4	
MW-13D	24	Sand & Silt	77.88	-0.003	78.15	-0.007	77.27	-0.006	77.67	-0.003	77.65	-0.003	77.94	-0.005	77.50	-0.004
MW-13D		Sand & Silt	77.88		78.15		77.27		77.67		77.65		77.94		77.50	
MW-13B	19	Bedrock	77.76	0.006	78.14	0.001	77.06	0.011	77.67	0.000	77.58	0.004	78.08	-0.007	77.43	0.004
MW-16D		Sand & Silt	78.04		78.57		77.57		77.94		78.29		78.24		77.78	
MW-16B	21	Bedrock	77.97	0.003	78.43	0.007	77.48	0.004	77.88	0.003	77.91	0.018	78.21	0.001	77.68	0.005
MW-17S		Sand	77.92		78.78		77.80		77.88		77.90		78.07		77.89	
MW-17D	38	Sand	77.98	-0.002	78.77	0.000	77.78	0.001	77.94	-0.002	77.95	-0.001	78.15	-0.002	77.94	-0.001
MW-17D		Sand	77.98		78.77		77.78		77.94		77.95		78.15		77.94	
MW-17B	24	Bedrock	78.24	-0.011	78.79	-0.001	77.81	-0.001	78.17	-0.010	78.15	-0.008	77.96	0.008	78.05	-0.005
MW-18D		Sand & Silt	79.51		79.68		77.84		79.44		79.49		79.66		78.85	
MW-18B	18	Bedrock	79.31	0.011	79.60	0.004	77.89	-0.003	79.25	0.011	79.27	0.012	79.44	0.012	78.69	0.009
MW-19S		Sand	84.14		84.02		81.59		83.79		84.05		84.87		82.66	
MW-19D	28	Sand & Silt	84.40	-0.009	84.50	-0.017	82.01	-0.016	84.24	-0.016	84.52	-0.016	84.85	0.001	83.26	-0.022
MW-19D		Sand & Silt	84.40		84.50		82.01		84.24		84.52		84.85		83.26	
MW-19B	25	Bedrock	85.23	-0.033	85.41	-0.036	82.61	-0.024	85.01	-0.030	85.38	-0.034	85.71	-0.034	83.93	-0.026
MW-21		Sand	78.22		78.57		77.52		78.27		78.63		78.33		78.07	
MW-21M	14	Sand & Silt	78.21	0.001	78.56	0.001	77.51	0.001	78.18	0.006	78.10	0.036	78.21	0.008	77.97	0.007
MW-22M		Sand	NI		78.81		77.74		78.15		78.15		78.27		78.02	
MW-22B	30	Bedrock	NI	NA	77.83	0.033	78.02	-0.009	78.76	-0.020	78.50	-0.012	79.00	-0.024	78.46	-0.015
PMW-6		Sand	84.98		85.79		81.49		84.83		85.89		86.92		82.55	
MW-23B	44	Bedrock	84.09	0.020	84.70	0.024	82.09	-0.015	84.26	0.013	84.72	0.026	85.01	0.042	83.16	-0.015
MW-24		Sand	NI		NI		NI		79.33		79.67		81.26		78.22	
MW-24M	16	Sand	NI	NA	NI	NA	NI	NA	78.21	0.068	78.39	0.078	79.09	0.132	77.91	0.019
MW-25		Sand & Silt	NI		NI		NI		81.06		84.33		87.31		77.53	
MW-25M	13	Sand & Silt	NI	NA	NI	NA	NI	NA	78.92	0.166	79.45	0.378	80.43	0.533	78.68	-0.089

NOTE:

1. Distances between well screens involving shallow groundwater wells represents distance between the average water elevation at that shallow groundwater well (2004-2006) and the top of the well screen at the intermediate/bedrock wells. All gradients, however, are calculated based on measurements made during the specified event. All elevations in feet above or below (-) North American Datum of 1988.

NM = Not Measured

NI = Not Installed for Measurement

NA = Not Applicable (No data for Calculation)

ft = feet

ft/ft = feet per foot

Table 4-8

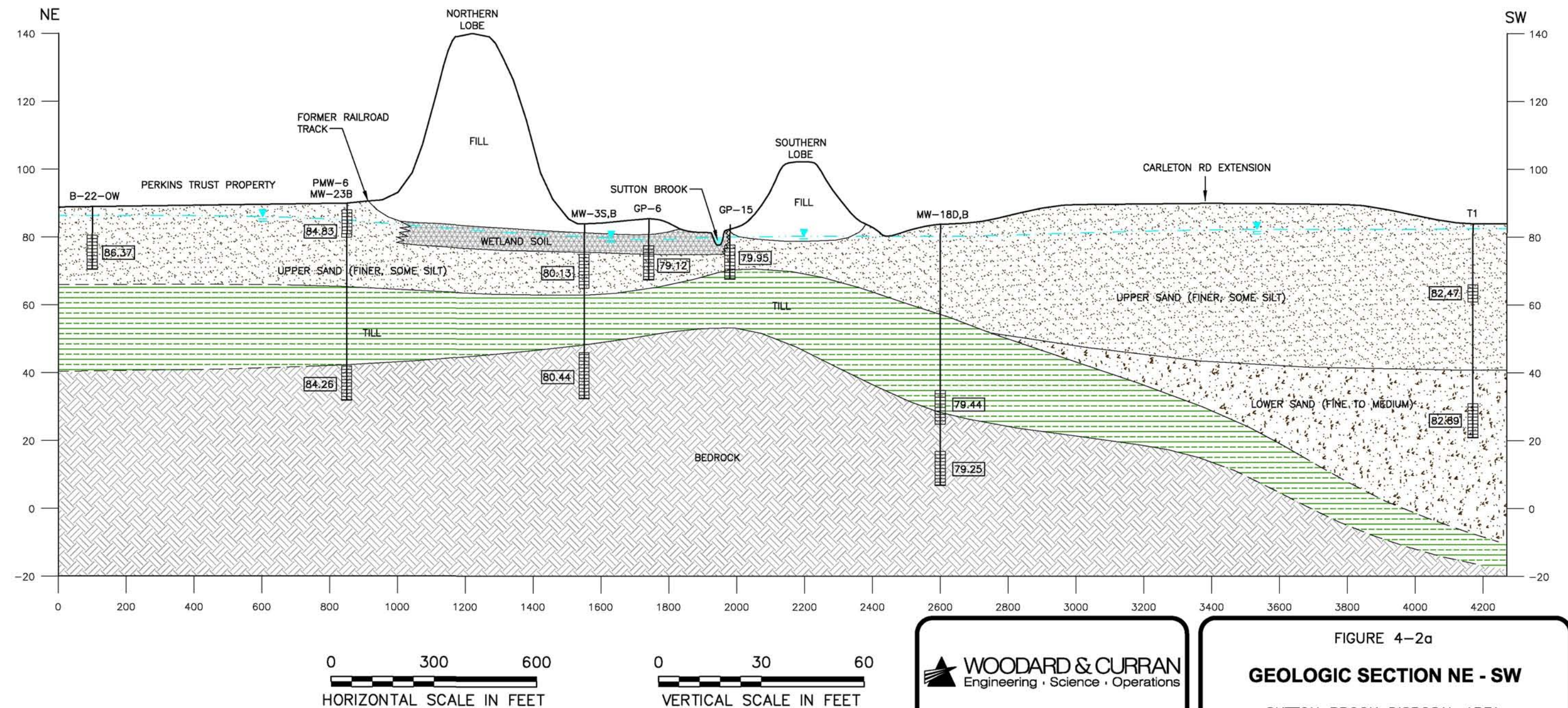
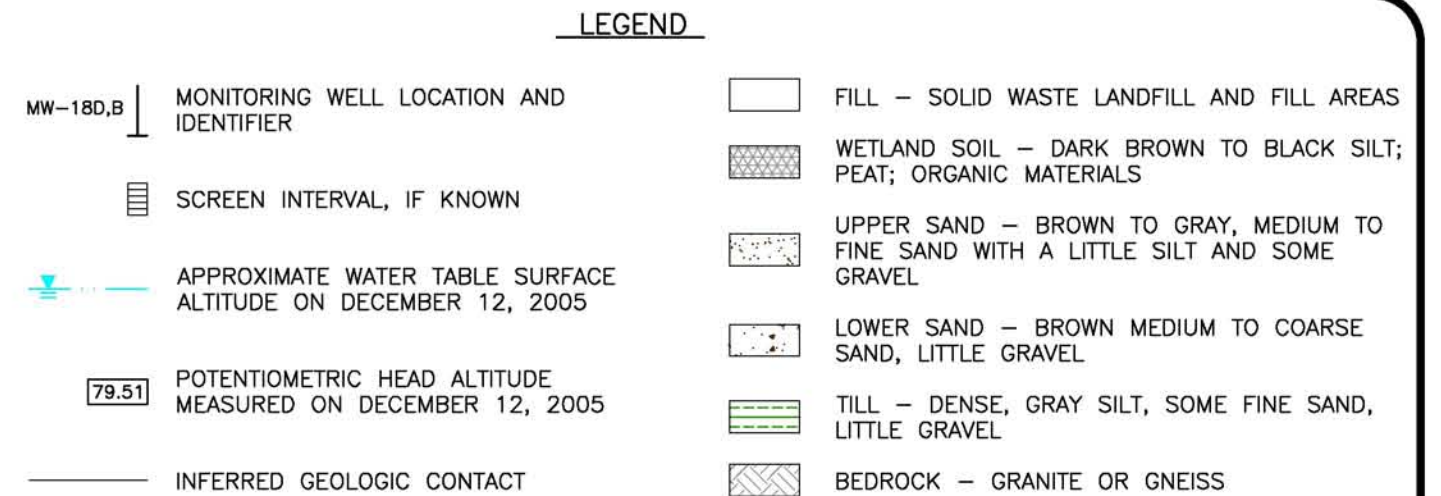
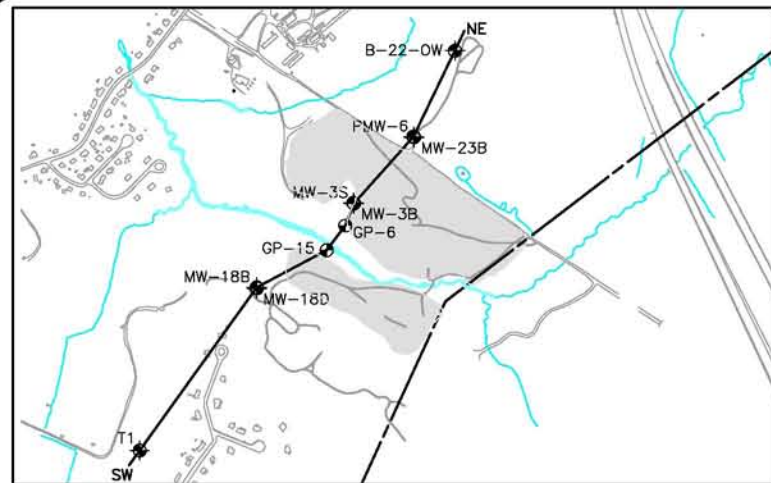
Summary of Hydraulic Conductivity Measurements
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

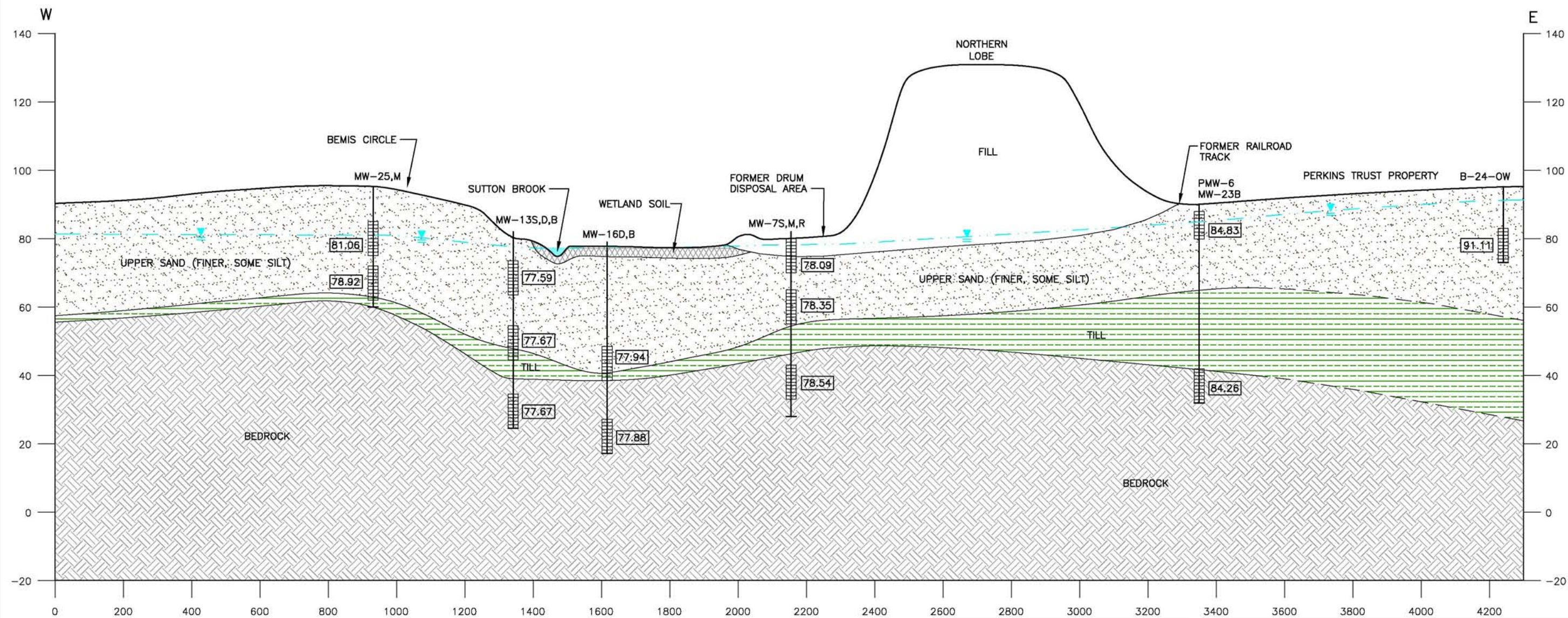
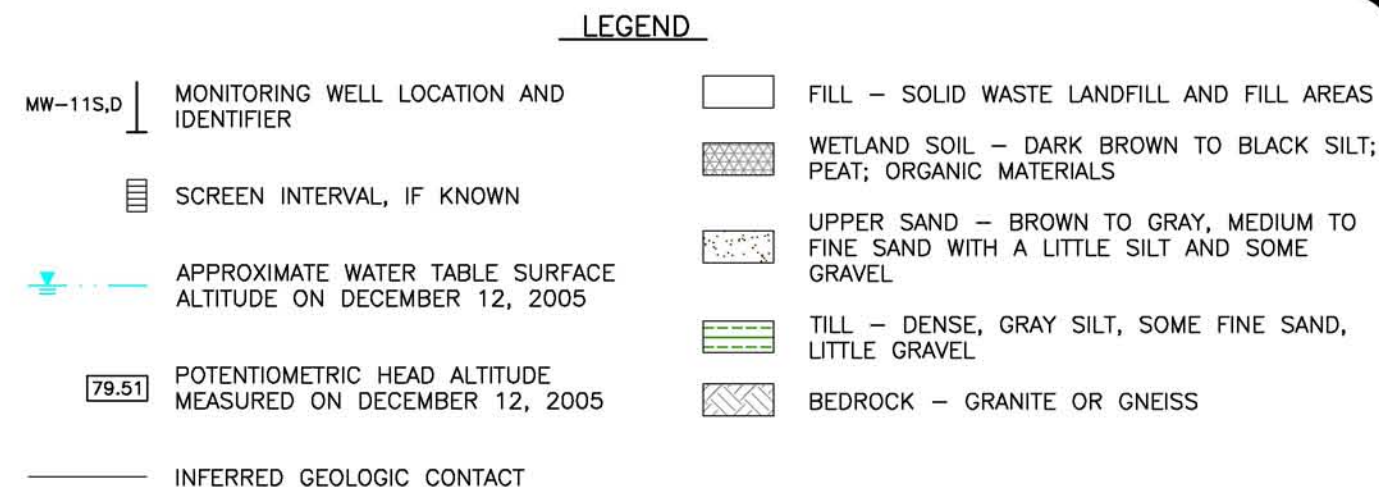
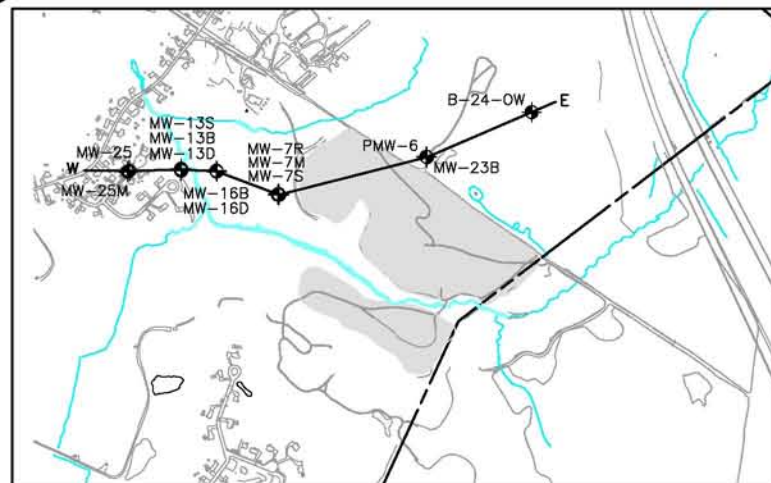
Monitoring Well Identification	Aquifer Properties			Test Method	Estimated Hydraulic Conductivity (K)			
	Well Screen Elevation	Screened Materials	Aquifer Thickness (ft)		K (ft/day)	K (cm/s)	Average	
							(cm/s)	(ft/day)
Water Table Wells								
MW-3S	74.8 - 64.8	Gray fine Sand, little to trace medium sand	32	Falling Head	58.32	2.06E-02	9.36E-03	26.5
MW-7S	79.9 - 69.9	Brown, coarse to fine sand (fill) to gray silty sand	32	Rising Head	43.32	1.53E-02		
				Falling Head	2.29	8.08E-04		
MW-17S	75.6 - 65.6	Tan to gray, medium to fine sand	51	Rising Head	2.63	9.28E-04		
				Falling Head	28.46	1.00E-02		
				Rising Head	24.03	8.48E-03		
Intermediate Wells								
MW-4S	66.4 - 56.4	Gray very fine sand, stratified w/ oxidized seams	27	Falling Head	1.43	5.05E-04	1.02E-03	2.9
MW-9	62 - 52	Gray, fine sand, trace silt	50	Falling Head	6.14	2.17E-03		
				Rising Head	4.83	1.70E-03		
MW-7M	63.6 - 53.6	Tan to gray silty fine sand	32	Falling Head	1.14	4.02E-04		
				Rising Head	0.896	3.16E-04		
Deeper Overburden Wells								
MW-17D	40.3 - 30.3	Tan, medium to fine sand, trace silt, trace fine gravel	51	Falling Head	10.96	3.87E-03	4.20E-03	11.9
				Rising Head	12.84	4.53E-03		
Bedrock Wells								
MW-3B	45.9 - 32.4	Granodiorite	48	Falling Head	0.052	1.84E-05	2.45E-04	0.70
MW-4B	47.4 - 37.4	Granodiorite	37	Falling Head				
				Rising Head	3.19	1.13E-03		
MW-7R	42.7 - 32.7	Very hard Gneiss	45	Falling Head	0.169	5.97E-05		
				Rising Head	0.054	1.91E-05		
MW-17B	16.5 - 6.5	Moderately hard, fractured fine to medium grained gray granite underlain by moderately hard gray amphibolite	67	Falling Head	0.011	3.88E-06		
Notes: Estimated Hydraulic Conductivity calculated utilizing Bouwer-Rice Solution Method. Elevations referenced to North American Datum of 1988. ft = feet cm/s = centimeters per second								



- SWAMP DEPOSITS
- KAME PLAIN DEPOSIT
- KAME TERRACE DEPOSIT

SOURCE: SURFICIAL GEOLOGY OF THE WILMINGTON QUADRANGLE, USGS, 1959.





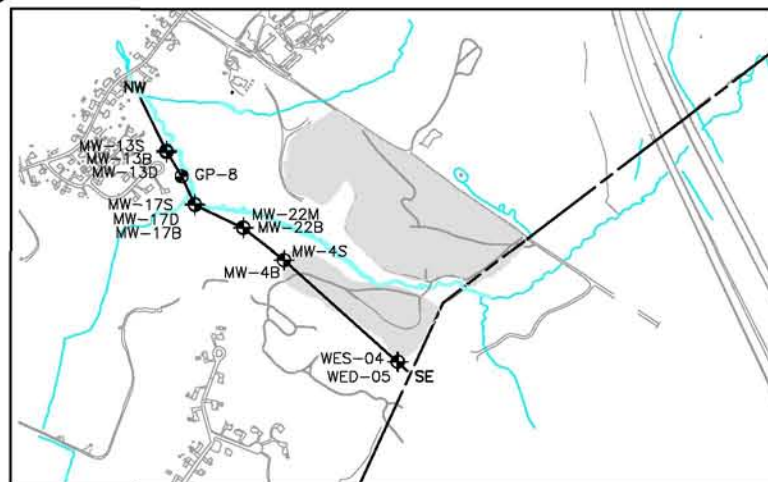
0 300 600
HORIZONTAL SCALE IN FEET

0 30 60
VERTICAL SCALE IN FEET

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FIGURE 4-2b
GEOLOGIC SECTION W - E
SUTTON BROOK DISPOSAL AREA

IMAGE Files: <No Images>
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\\Andover\projects\210517 Sutton Brook\wip\Drawings\RI 2-07\Section 4\ANSBSC02.dwg
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Softdesk Project: <none>



LEGEND

- MW-18D,B | MONITORING WELL LOCATION AND IDENTIFIER
- ▤ SCREEN INTERVAL, IF KNOWN
- APPROXIMATE WATER TABLE SURFACE ALTITUDE ON DECEMBER 12, 2005
- 79.51 POTENTIOMETRIC HEAD ALTITUDE MEASURED ON DECEMBER 12, 2005
- INFERRED GEOLOGIC CONTACT

- FILL — SOLID WASTE LANDFILL AND FILL AREAS
- ▨ WETLAND SOIL — DARK BROWN TO BLACK SILT; PEAT; ORGANIC MATERIALS
- ▧ UPPER SAND — BROWN TO GRAY, MEDIUM TO FINE SAND WITH A LITTLE SILT AND SOME GRAVEL
- ▩ LOWER SAND — BROWN MEDIUM TO COARSE SAND, LITTLE GRAVEL
- ▨ TILL — DENSE, GRAY SILT, SOME FINE SAND, LITTLE GRAVEL
- ▩ BEDROCK — GRANITE OR GNEISS

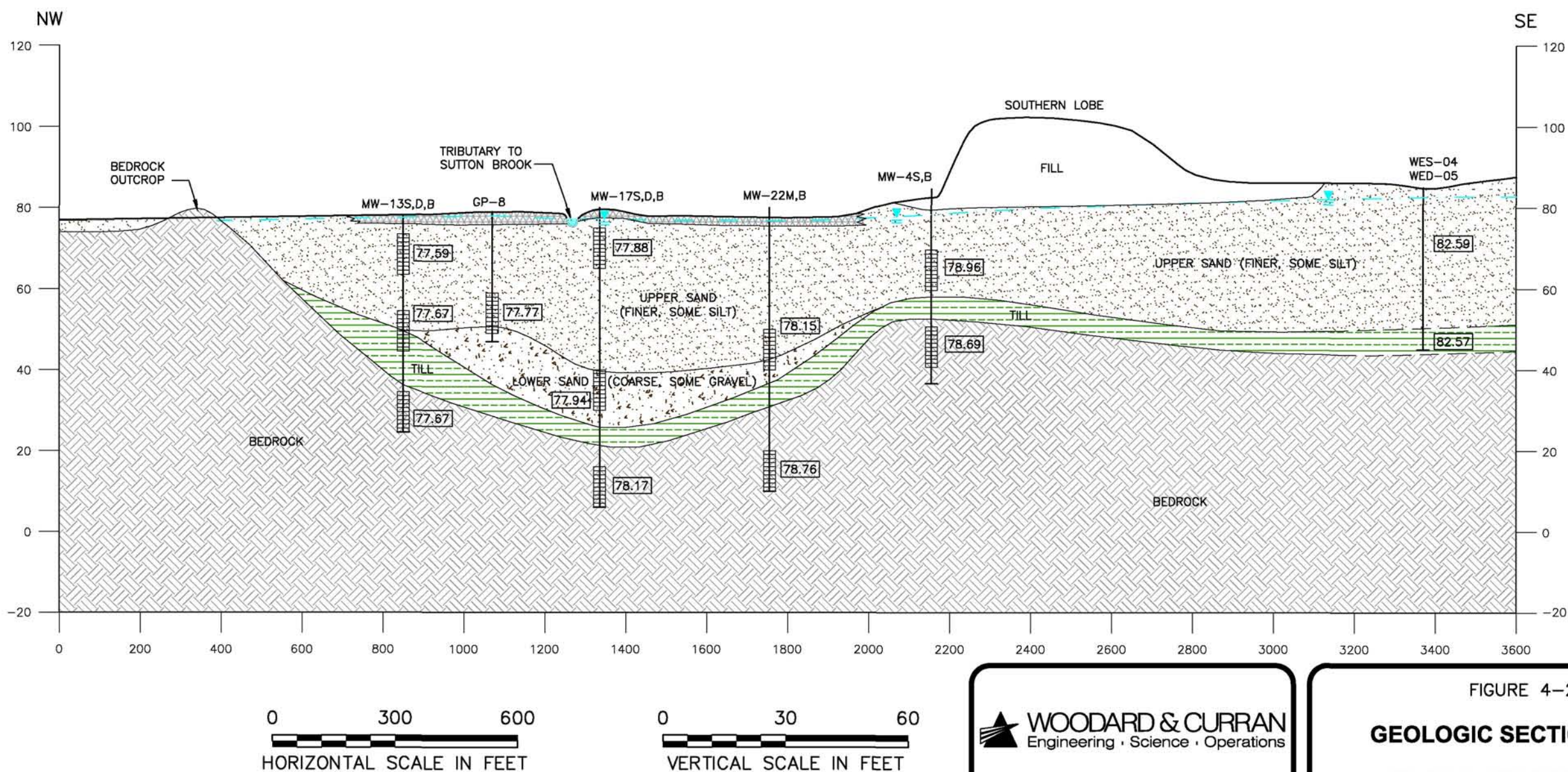


FIGURE 4-2c

GEOLOGIC SECTION NW-SE

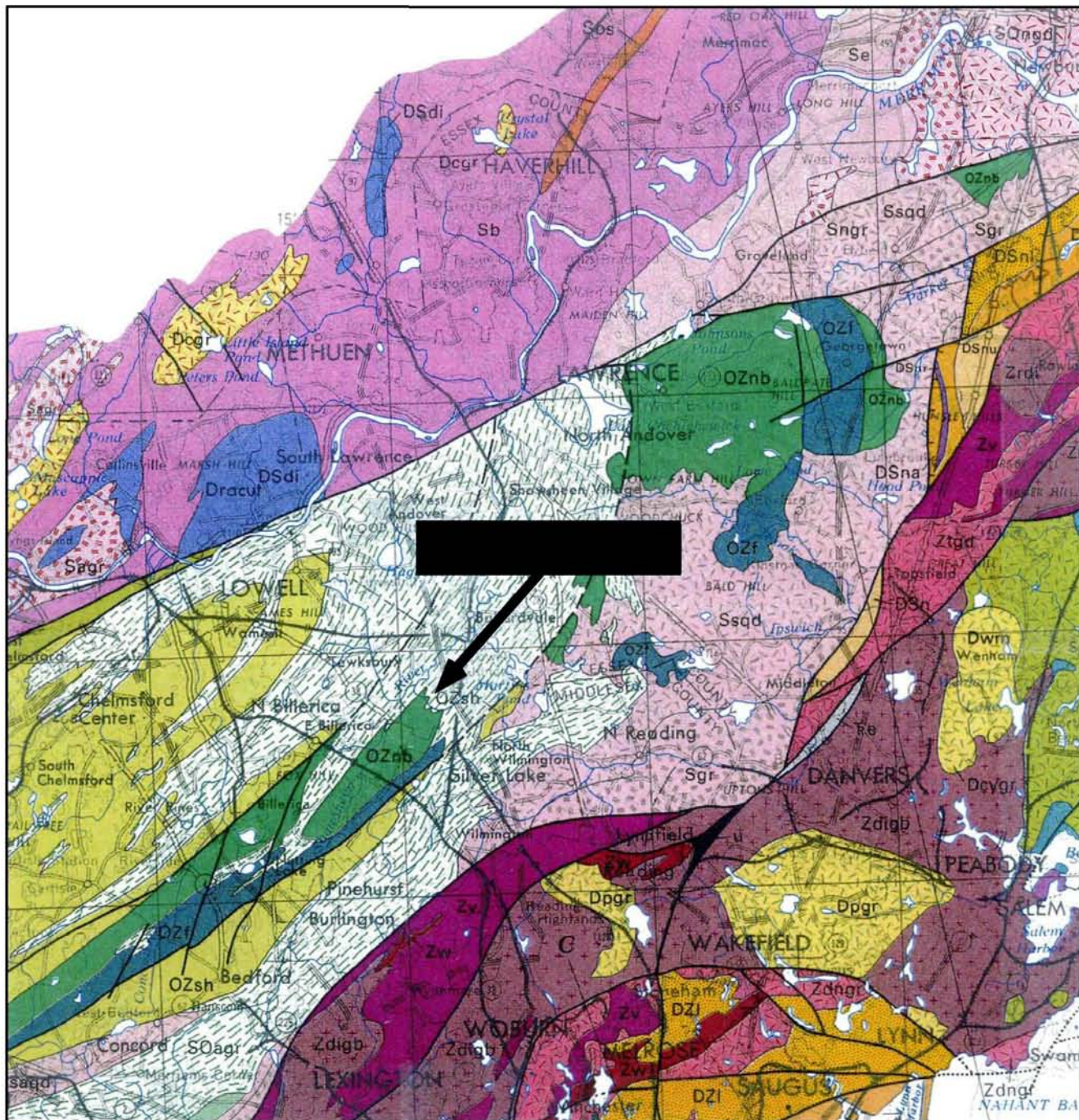
SUTTON BROOK DISPOSAL AREA

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0 300 600
HORIZONTAL SCALE IN FEET

0 30 60
VERTICAL SCALE IN FEET

IMAGE Files: <No Images>
XREF Files: ANSBB-01.dwg
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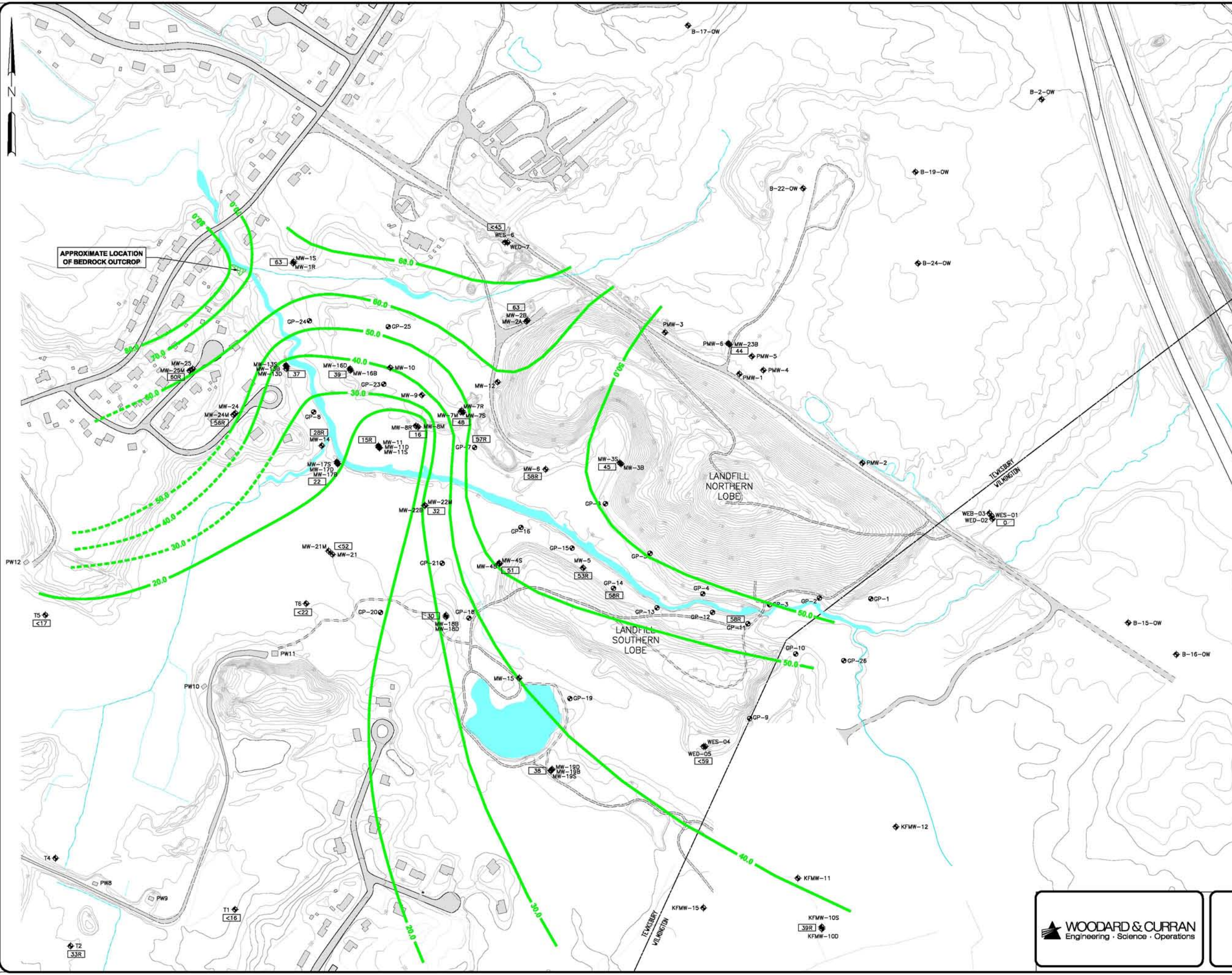
SOagr ANDOVER GRANITE – LIGHT TO MEDIUM – GRAY, FOLIATED, MEDIUM TO COARSE GRAINED MUSCOVITE – BIOTITE GRANITE, PEGMATITE MASSES COMMON.

OZnb THIN BEDDED TO MASSIVE AMPHIBOLITE, MINOR BIOTITE GNEISS

— FAULT

SOURCE: USGS, BEDROCK GEOLOGY MAP OF MASSACHUSETTS ZEN, 1983.

\\woodard-curran\projects\110117 Sutton Brook\GIS\Drawings\110117-01.dwg
DATE: 11/15/17
BY: JAC
CHECKED BY: JAC
SCALE: AS SHOWN
PLOT DATE: 11/15/17



LEGEND

MW-19 MONITORING WELL LOCATION AND IDENTIFIER

GP-6 TEMPORARY WELL LOCATION AND IDENTIFIER

APPROXIMATE BEDROCK SURFACE ELEVATION IN FEET, CONTOUR INTERVAL 10 FEET.

BEDROCK SURFACE ELEVATION IN FEET
R = REFUSAL WITH AUGERS OR CASING
< = BEDROCK NOT ENCOUNTERED DURING DRILLING ACTIVITIES, VALUE PRESENTED REFERS TO THE ELEVATION OF THE BOTTOM OF THE BORING.

UNPAVED ROAD PAVED ROAD

WATER BUILDING

NOTES:

1. THE TOPOGRAPHIC AND PLANIMETRIC FEATURES AS SHOWN PROVIDED BY THE TOWN OF TEWKSBURY, MASSACHUSETTS, DEPARTMENT OF PUBLIC WORKS, AND ARE BASED UPON AERIAL PHOTOGRAMMETRIC MAPPING COMPLETED BY JAMES W. SEWALL COMPANY OF OLD TOWN, MAINE FROM AERIAL PHOTOGRAPHS DATED MARCH 29, 1985. THE MAP IS REPORTED TO MEET NATIONAL MAP ACCURACY STANDARDS FOR 1"=100' MAPS WITH 2 FOOT CONTOURS. WOODARD & CURRAN HAS NOT FIELD VERIFIED AND IS NOT RESPONSIBLE FOR ACCURACY OF SAME.

2. THE GROUND SURFACE TOPOGRAPHIC VERTICAL DATUM REFERENCED IS EXPRESSED IN FEET AND BASED UPON THE USGS NORTH AMERICAN VERTICAL DATUM OF 1929 (NAVD29), AS ESTABLISHED BY OTHERS.

3. THE BEDROCK SURFACE ELEVATION VERTICAL DATUM REFERENCED IS EXPRESSED IN FEET AND BASED UPON THE USGS NORTH AMERICAN DATUM OF 1988, AS ESTABLISHED BY OTHERS.

4. THE LOCATIONS OF ENVIRONMENTAL SAMPLING POINTS INCLUDING BUT NOT LIMITED TO MONITORING WELLS, SOIL BORINGS, PIEZOMETERS, SURFACE WATER SAMPLING POINTS, AND SOIL GAS SAMPLING POINTS WERE ESTABLISHED BY WOODARD & CURRAN PERSONNEL IN THE FIELD USING A TRIMBLE MODEL GLOBAL POSITIONING SYSTEM (GPS) REFERENCE THE NAD27 MASSACHUSETTS STATE PLANE COORDINATE SYSTEM.

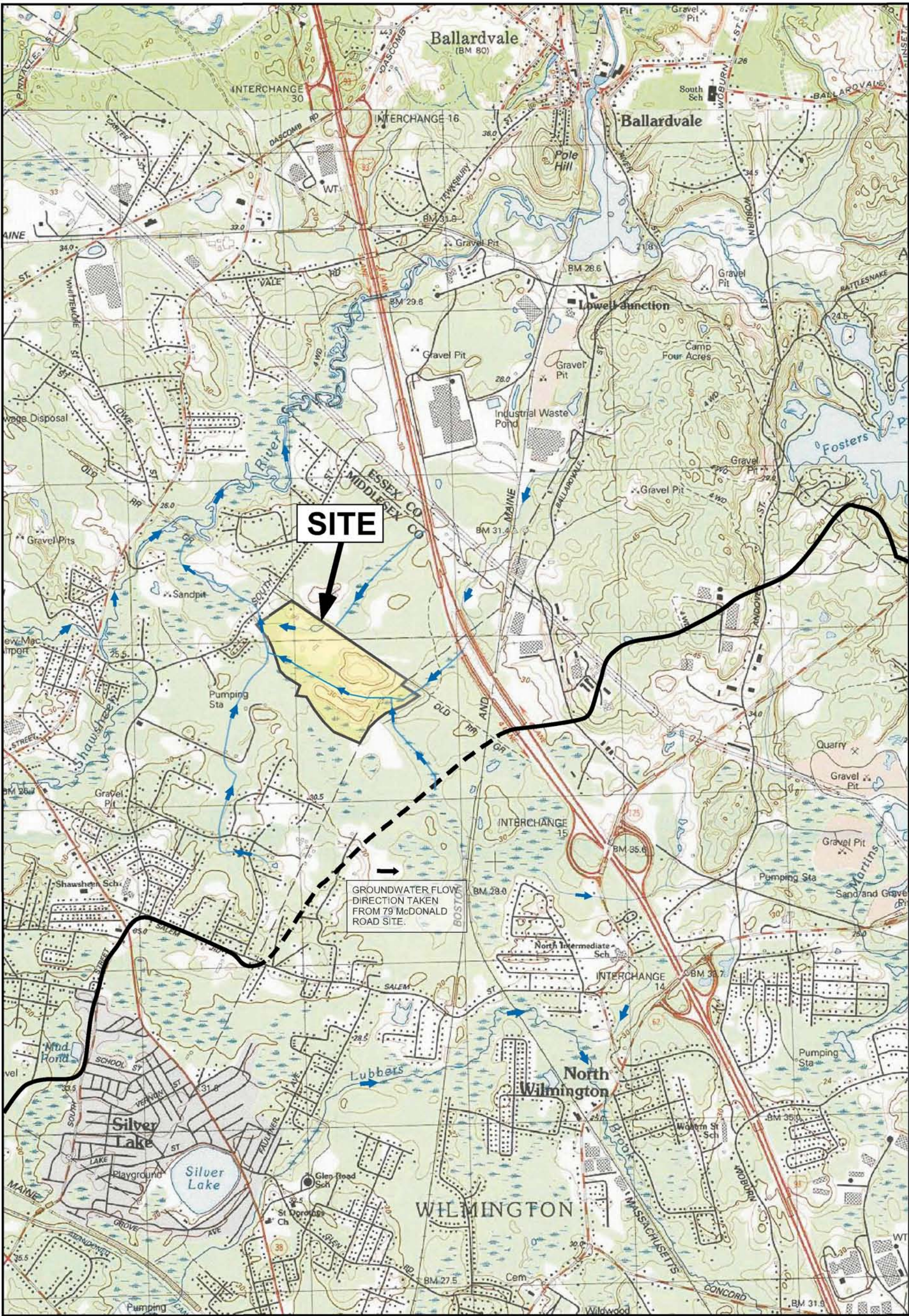
5. THE SURVEY DATA AS PRESENTED ON THIS PLAN WAS CORRECT AT THE TIME THIS PLAN WAS PRODUCED. ANY AND ALL DATA IS SUBJECT TO CHANGE WITH TIME AND WE ASSUME NO RESPONSIBILITY FOR THE USE OF INCORRECT OR OUTDATED INFORMATION. FOR VERIFICATION OR UPDATE OF SURVEY DATA FOR THIS SITE CONTACT WOODARD & CURRAN. WOODARD & CURRAN HAS NOT CONDUCTED PROPERTY BOUNDARY OR EASEMENT SURVEYS.

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FIGURE 4-4

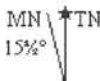
**APPROXIMATE CONFIGURATION OF
THE BEDROCK SURFACE**

SUTTON BROOK DISPOSAL AREA




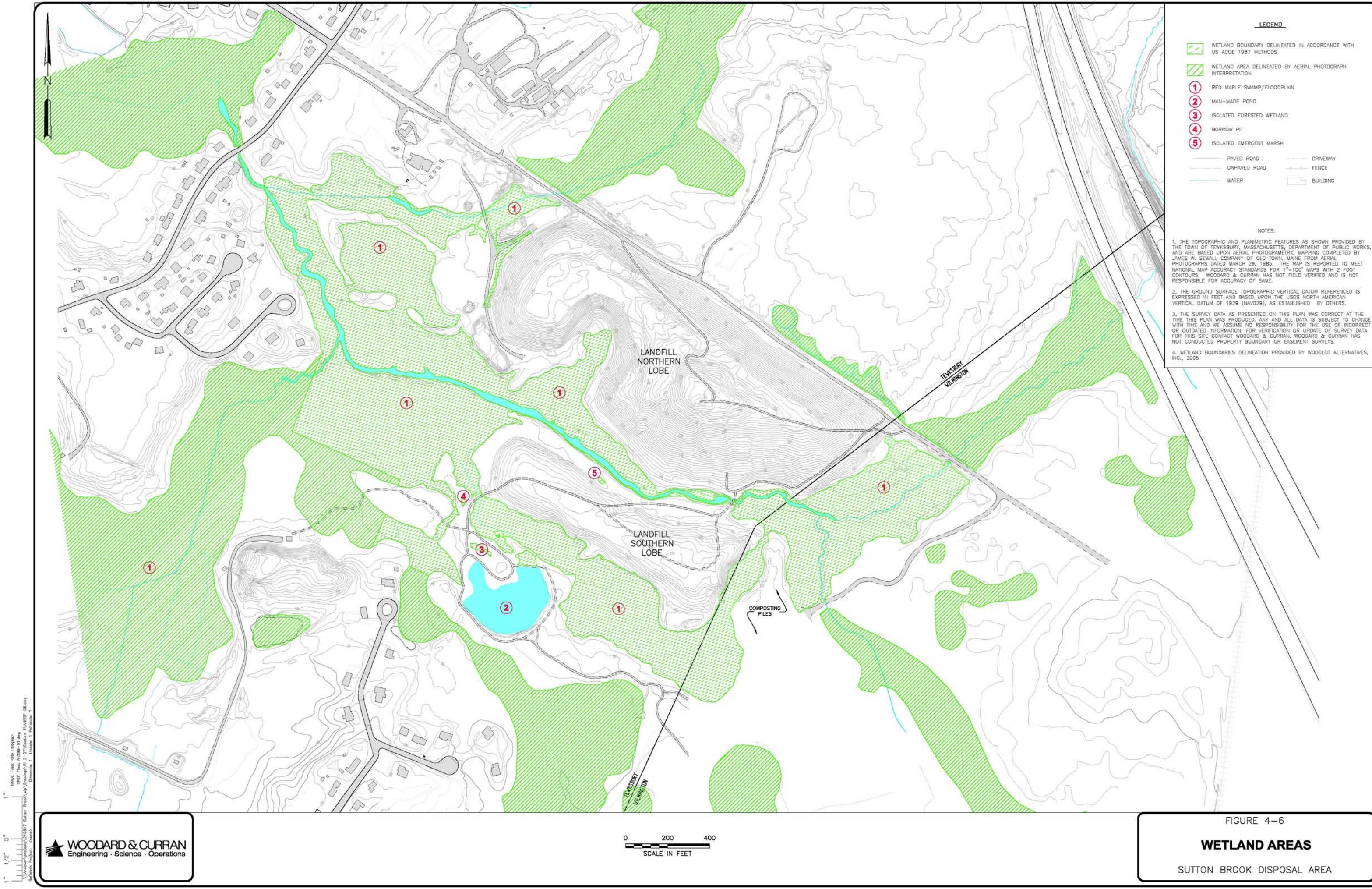
LEGEND

-  SURFACE WATER FLOW DIRECTION
-  SHAWSHEEN RIVER DRAINAGE BASIN (DASHED WHERE INFERRED BY W&C) (TAKEN FROM USGS HYDROLOGIC ATLAS HA614)



Base Map Source:
TOPO!™ © 2000
Wildflower Productions

DES.BY:	DR.BY: EVR	CK.BY:
SUTTON BROOK DISPOSAL AREA TEWKSBURY, MASSACHUSETTS		
FIGURE 4-5 REGIONAL HYDROLOGICAL FEATURES		
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DATE: FEBRUARY 2007	FILE NAME: ANSBF-05.CNV	
 WOODARD & CURRAN Engineering • Science • Operations		



LEGEND

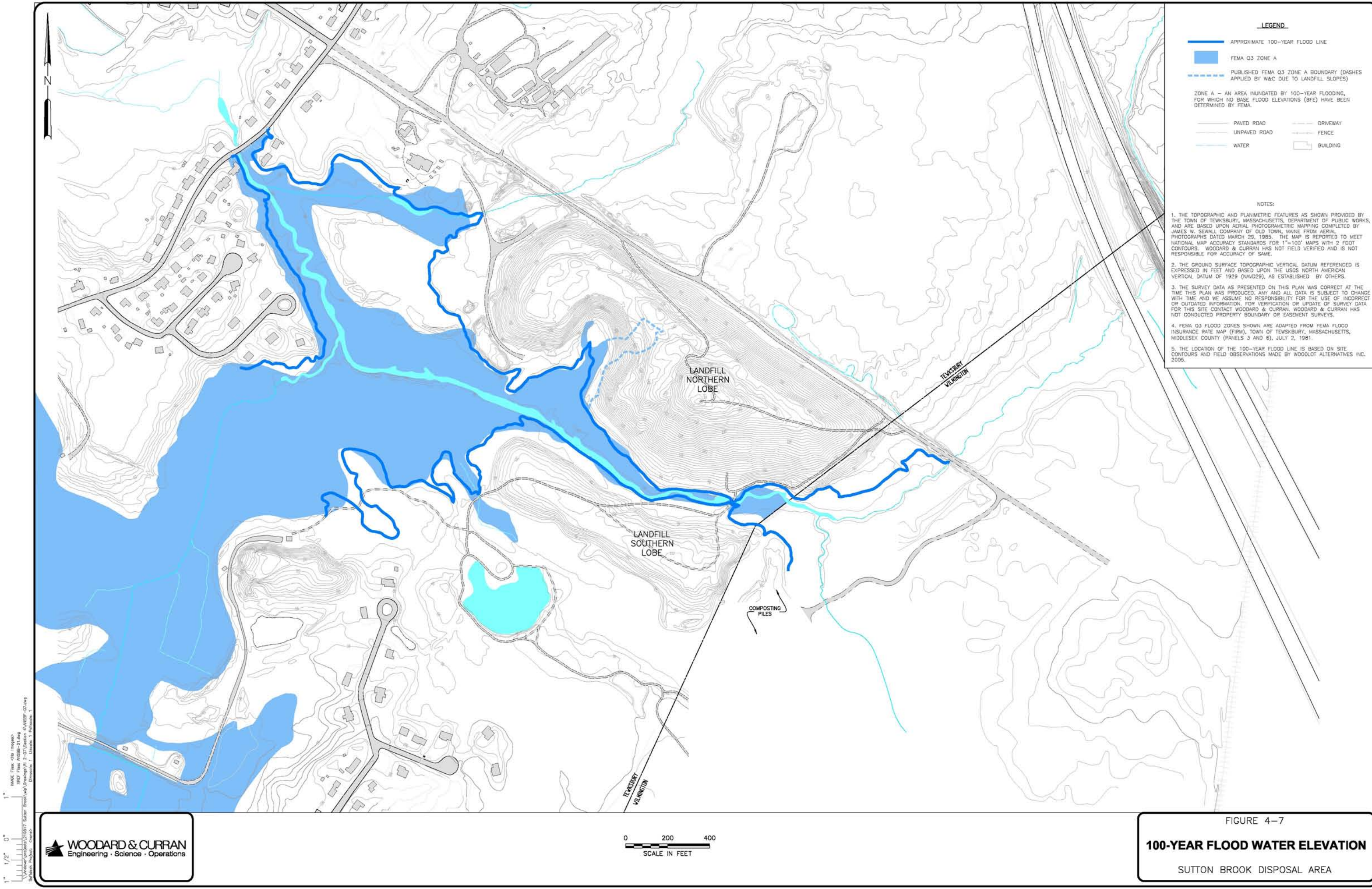
- WETLAND BOUNDARY DELINEATED IN ACCORDANCE WITH US ACOE 1987 METHODS
- WETLAND AREA DELINEATED BY AERIAL PHOTOGRAPH INTERPRETATION
- 1 RED MAPLE SWAMP/FLOODPLAIN
- 2 MAN-MADE POND
- 3 ISOLATED FORESTED WETLAND
- 4 BORROW PIT
- 5 ISOLATED EMERGENT MARSH
- PAVED ROAD
- UNPAVED ROAD
- WATER
- DRIVEWAY
- FENCE
- BUILDING

NOTES:

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2. THE GROUND SURFACE TOPOGRAPHIC VERTICAL DATUM REFERENCED IS EXPRESSED IN FEET AND BASED UPON THE USGS NORTH AMERICAN VERTICAL DATUM OF 1929 (NAVD29), AS ESTABLISHED BY OTHERS.
3. THE SURVEY DATA AS PRESENTED ON THIS PLAN WAS CORRECT AT THE TIME THIS PLAN WAS PRODUCED. ANY AND ALL DATA IS SUBJECT TO CHANGE WITH TIME AND WE ASSUME NO RESPONSIBILITY FOR THE USE OF INCORRECT OR OUTDATED INFORMATION. FOR VERIFICATION OR UPDATE OF SURVEY DATA FOR THIS SITE CONTACT WOODWARD & CURRAN. WOODWARD & CURRAN HAS NOT CONDUCTED PROPERTY BOUNDARY OR EASEMENT SURVEYS.
4. WETLAND BOUNDARIES DELINEATION PROVIDED BY WOODLOT ALTERNATIVES, INC., 2005

IMAGE FILE: <file images>
XREF FILE: MSDB-01.dwg
\\woodward\projects\171017 Sutton Brook\wbs\Drawings\17 2-07\Sutton Brook\171017.dwg
DATE: 1/1/2008 1:00:00 PM
USER: J. CURRAN

FIGURE 4-6
WETLAND AREAS
SUTTON BROOK DISPOSAL AREA



LEGEND

— APPROXIMATE 100-YEAR FLOOD LINE

■ FEMA Q3 ZONE A

--- PUBLISHED FEMA Q3 ZONE A BOUNDARY (DASHES APPLIED BY W&C DUE TO LANDFILL SLOPES)

ZONE A - AN AREA INUNDATED BY 100-YEAR FLOODING, FOR WHICH NO BASE FLOOD ELEVATIONS (BFE) HAVE BEEN DETERMINED BY FEMA.

— PAVED ROAD — DRIVEWAY

— UNPAVED ROAD — FENCE

— WATER □ BUILDING

NOTES:

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4. FEMA Q3 FLOOD ZONES SHOWN ARE ADAPTED FROM FEMA FLOOD INSURANCE RATE MAP (FIRM), TOWN OF TEWKSBURY, MASSACHUSETTS, MIDDLESEX COUNTY (PANELS 3 AND 6), JULY 2, 1981.

5. THE LOCATION OF THE 100-YEAR FLOOD LINE IS BASED ON SITE CONTOURS AND FIELD OBSERVATIONS MADE BY WOODLOT ALTERNATIVES INC. 2005.

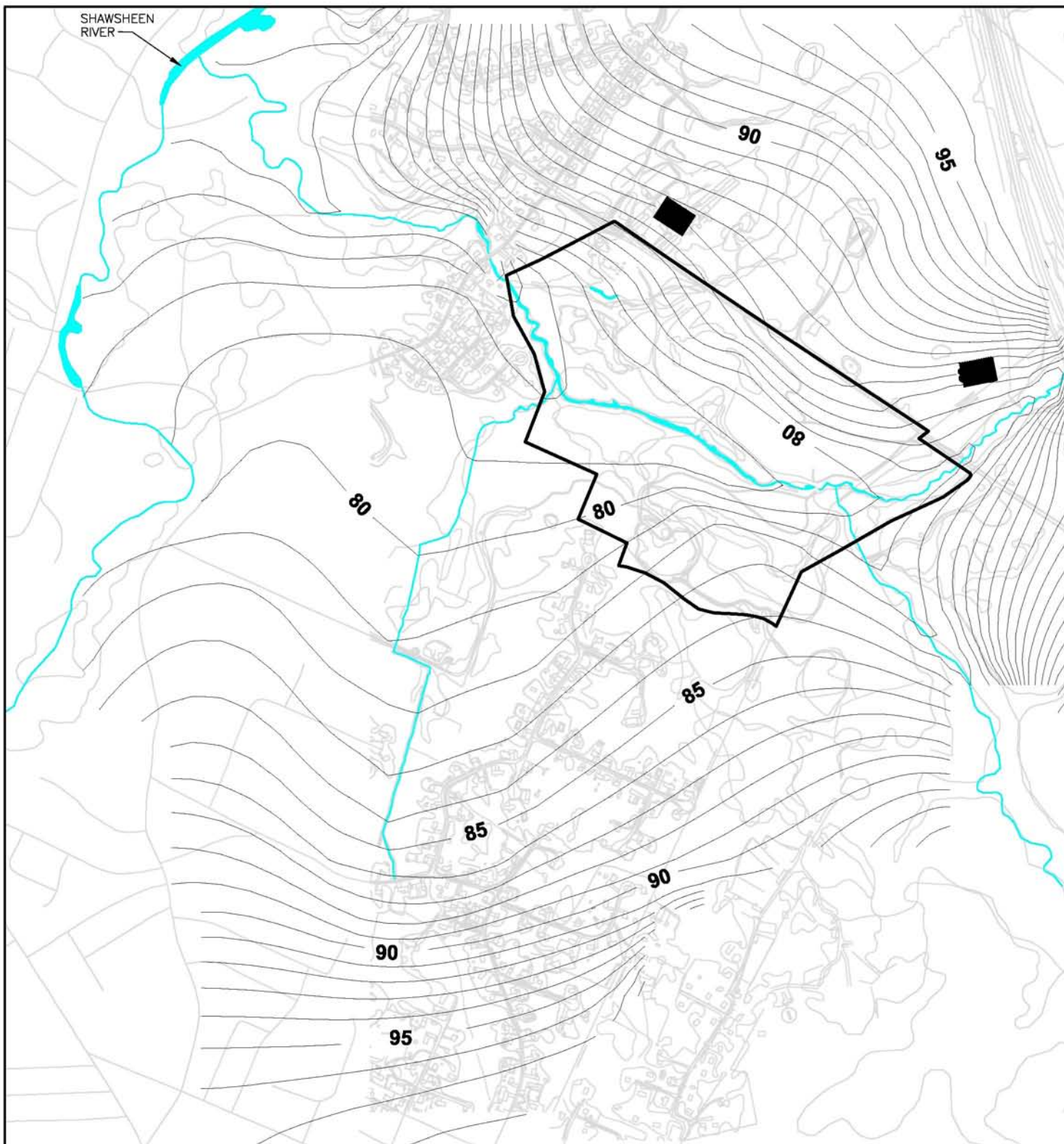
IMAGE FILE: <file image>
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FIGURE 4-7

100-YEAR FLOOD WATER ELEVATION

SUTTON BROOK DISPOSAL AREA



SHAWSHEEN
RIVER

90

95

08

80

80

85

85

90

90

95



LEGEND

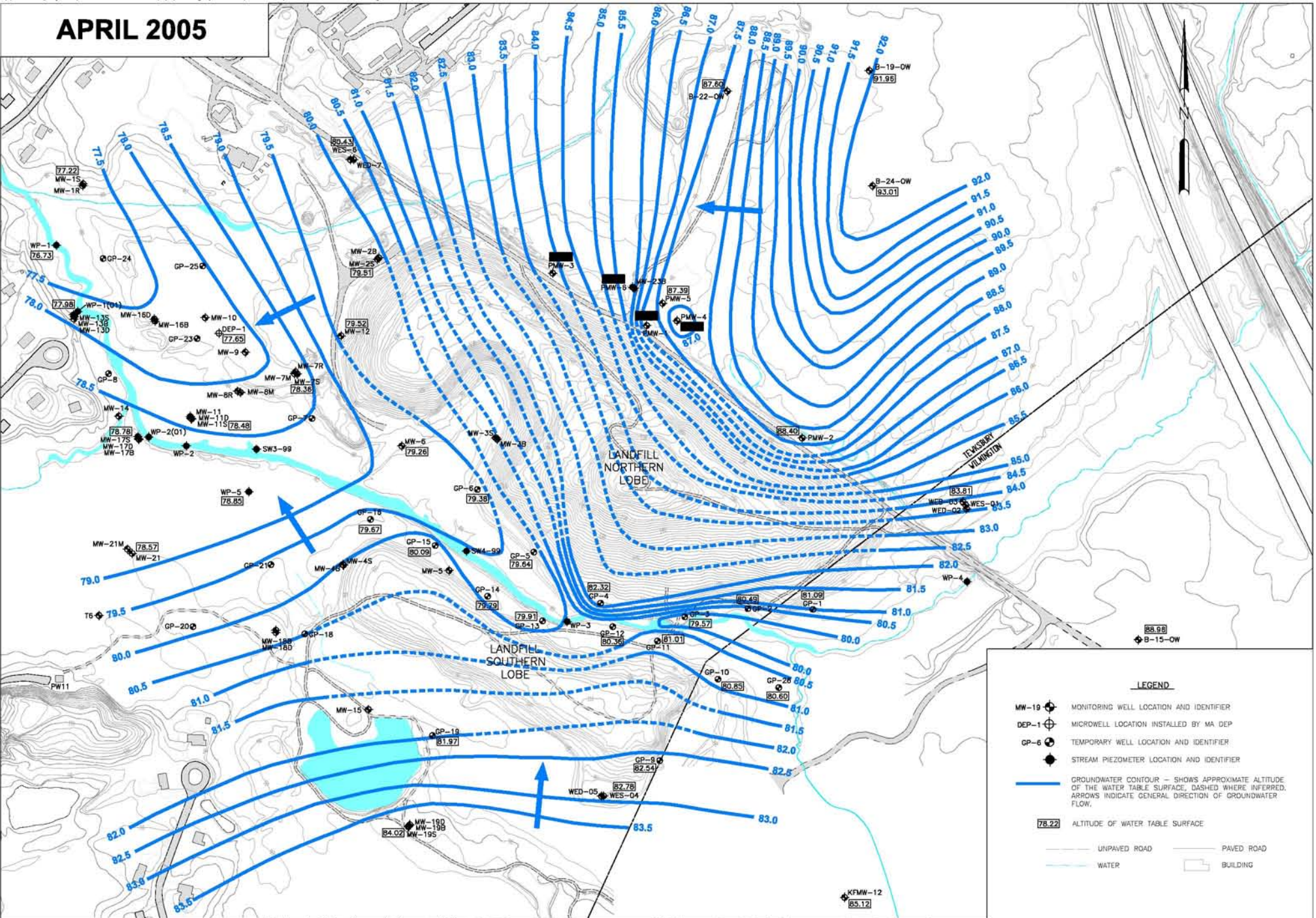
80

SIMULATED POTENTIOMETRIC
SURFACE FROM GROUNDWATER
FLOW MODEL (W&C, 2006)

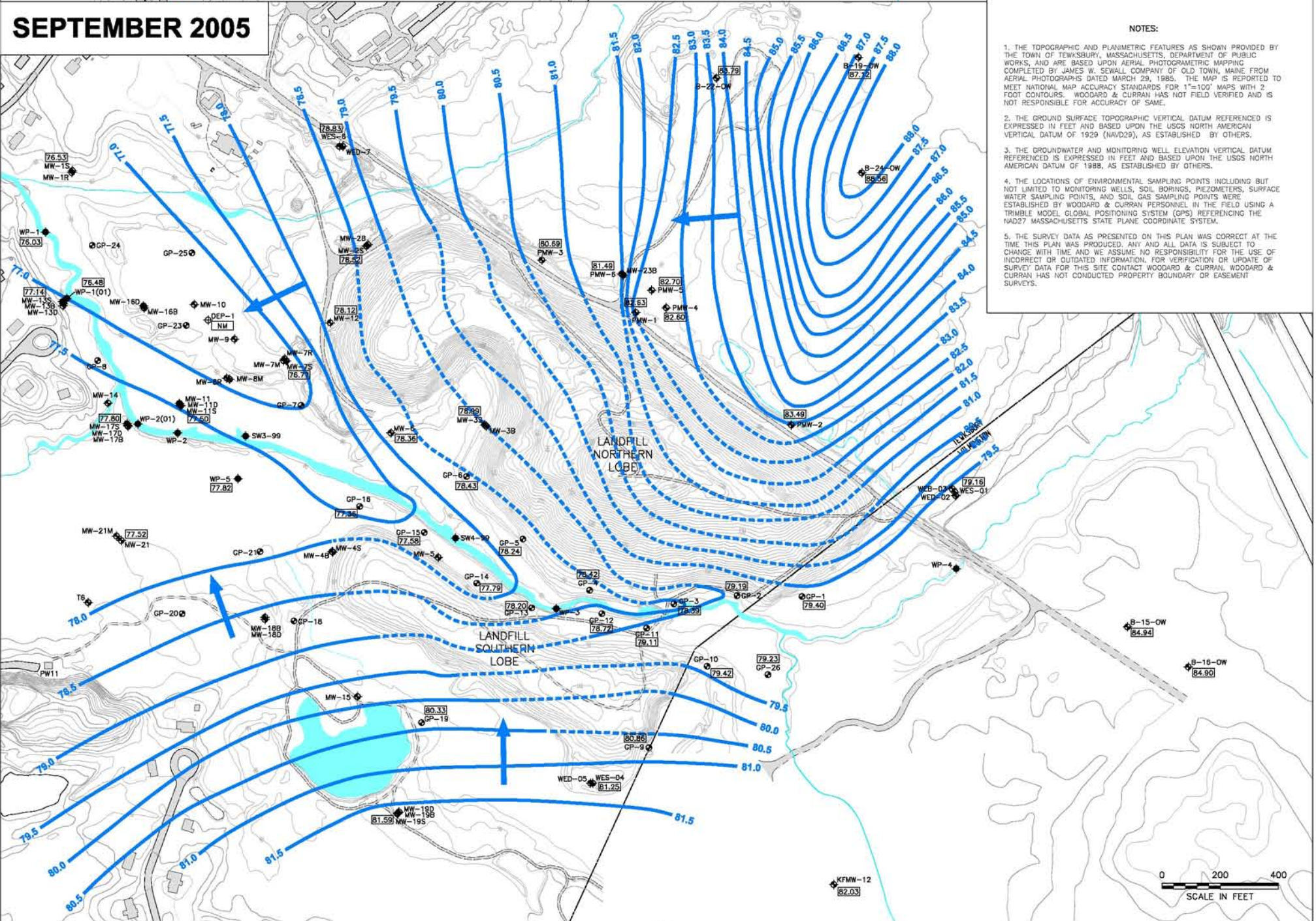


REMEDIAL INVESTIGATION AREA

APRIL 2005



SEPTEMBER 2005



NOTES:

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3. THE GROUNDWATER AND MONITORING WELL ELEVATION VERTICAL DATUM REFERENCED IS EXPRESSED IN FEET AND BASED UPON THE USGS NORTH AMERICAN DATUM OF 1988, AS ESTABLISHED BY OTHERS.
4. THE LOCATIONS OF ENVIRONMENTAL SAMPLING POINTS INCLUDING BUT NOT LIMITED TO MONITORING WELLS, SOIL BORINGS, PIEZOMETERS, SURFACE WATER SAMPLING POINTS, AND SOIL GAS SAMPLING POINTS WERE ESTABLISHED BY WOODARD & CURRAN PERSONNEL IN THE FIELD USING A TRIMBLE MODEL GLOBAL POSITIONING SYSTEM (GPS) REFERENCE THE NAD27 MASSACHUSETTS STATE PLANE COORDINATE SYSTEM.
5. THE SURVEY DATA AS PRESENTED ON THIS PLAN WAS CORRECT AT THE TIME THIS PLAN WAS PRODUCED. ANY AND ALL DATA IS SUBJECT TO CHANGE WITH TIME AND WE ASSUME NO RESPONSIBILITY FOR THE USE OF INCORRECT OR OUTDATED INFORMATION, FOR VERIFICATION OR UPDATE OF SURVEY DATA FOR THIS SITE CONTACT WOODARD & CURRAN. WOODARD & CURRAN HAS NOT CONDUCTED PROPERTY BOUNDARY OR EASEMENT SURVEYS.

FIGURE 4-9a

SUTTON BROOK DISPOSAL AREA

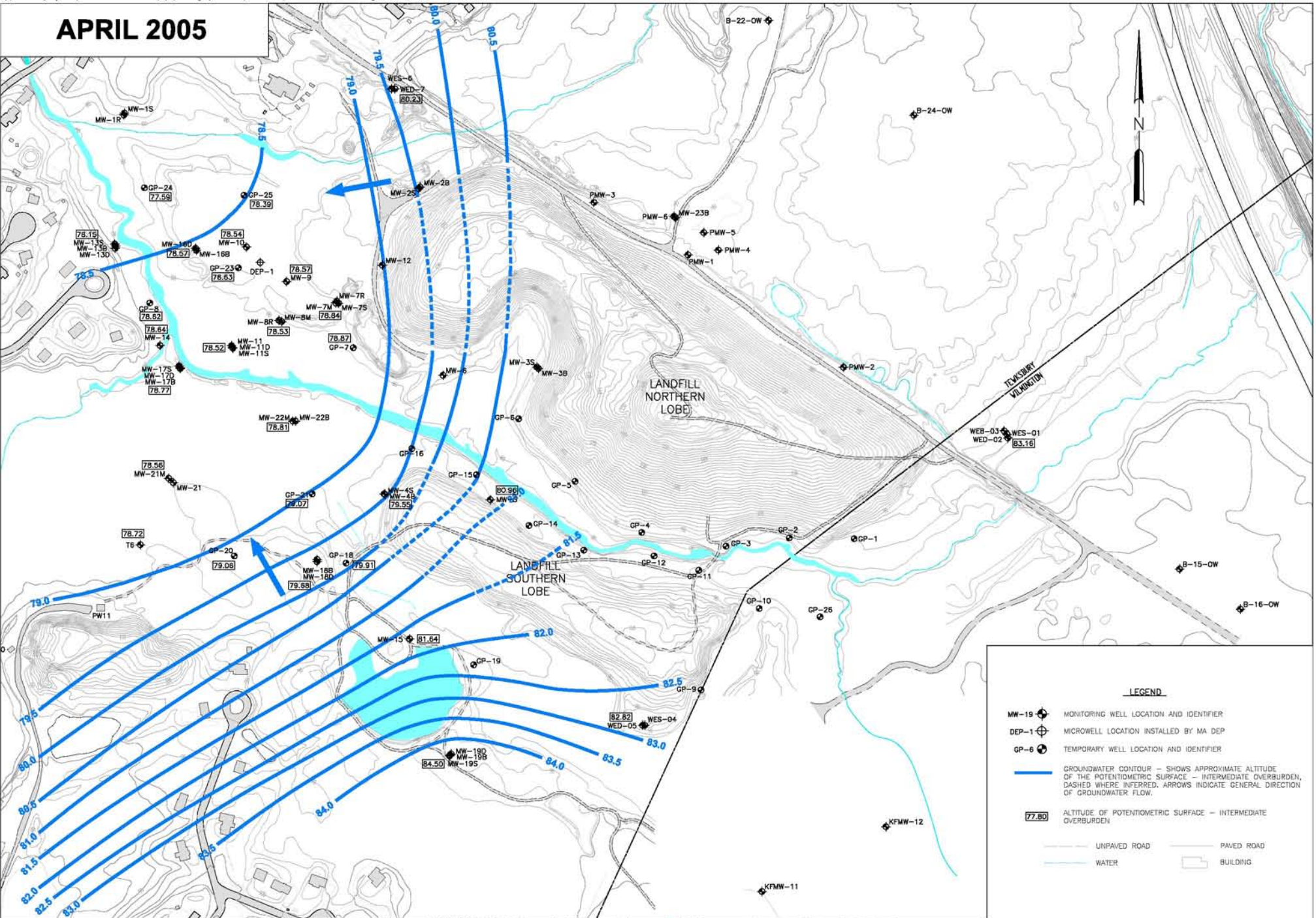
APPROXIMATE CONFIGURATION OF
WATER TABLE SURFACE
APRIL 20 & SEPTEMBER 19, 2005

REV	DESCRIPTION	DATE
DESIGNED BY:	CHECKED BY:	
DRAWN BY: EVR	ANSBF-02 W-T 4-9a.dwg	

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APRIL 2005



LEGEND

- MW-19 MONITORING WELL LOCATION AND IDENTIFIER
- DEP-1 MICROWELL LOCATION INSTALLED BY MA DEP
- GP-6 TEMPORARY WELL LOCATION AND IDENTIFIER
- GROUNDWATER CONTOUR - SHOWS APPROXIMATE ALTITUDE OF THE POTENTIOMETRIC SURFACE - INTERMEDIATE OVERBURDEN, DASHED WHERE INFERRED. ARROWS INDICATE GENERAL DIRECTION OF GROUNDWATER FLOW.
- 77.80 ALTITUDE OF POTENTIOMETRIC SURFACE - INTERMEDIATE OVERBURDEN
- UNPAVED ROAD
- PAVED ROAD
- WATER
- BUILDING

NOTES:

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SEPTEMBER 2005

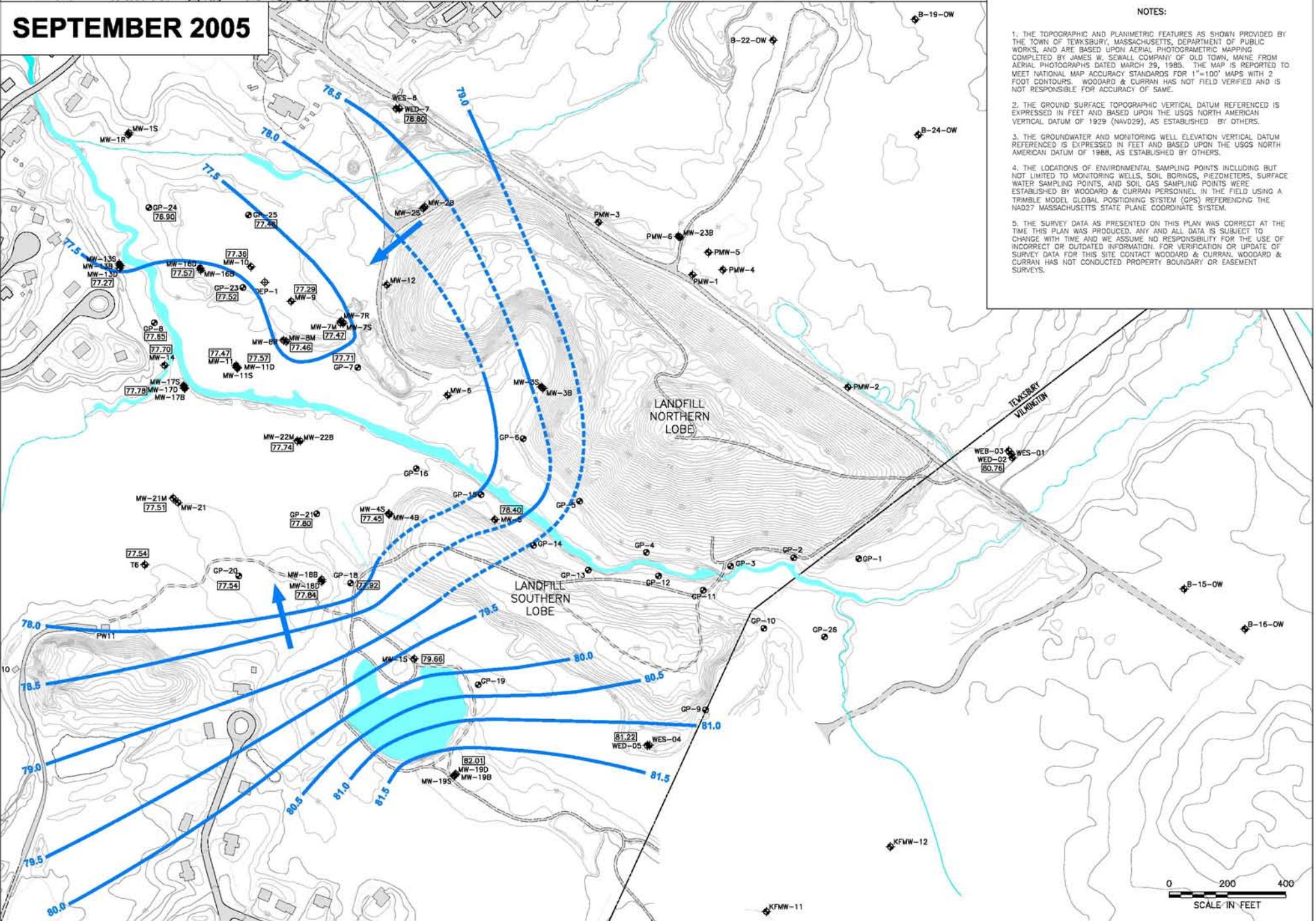


FIGURE 4-9b

DATE: FEBRUARY 2007
SCALE: AS NOTED
SHEET: 05

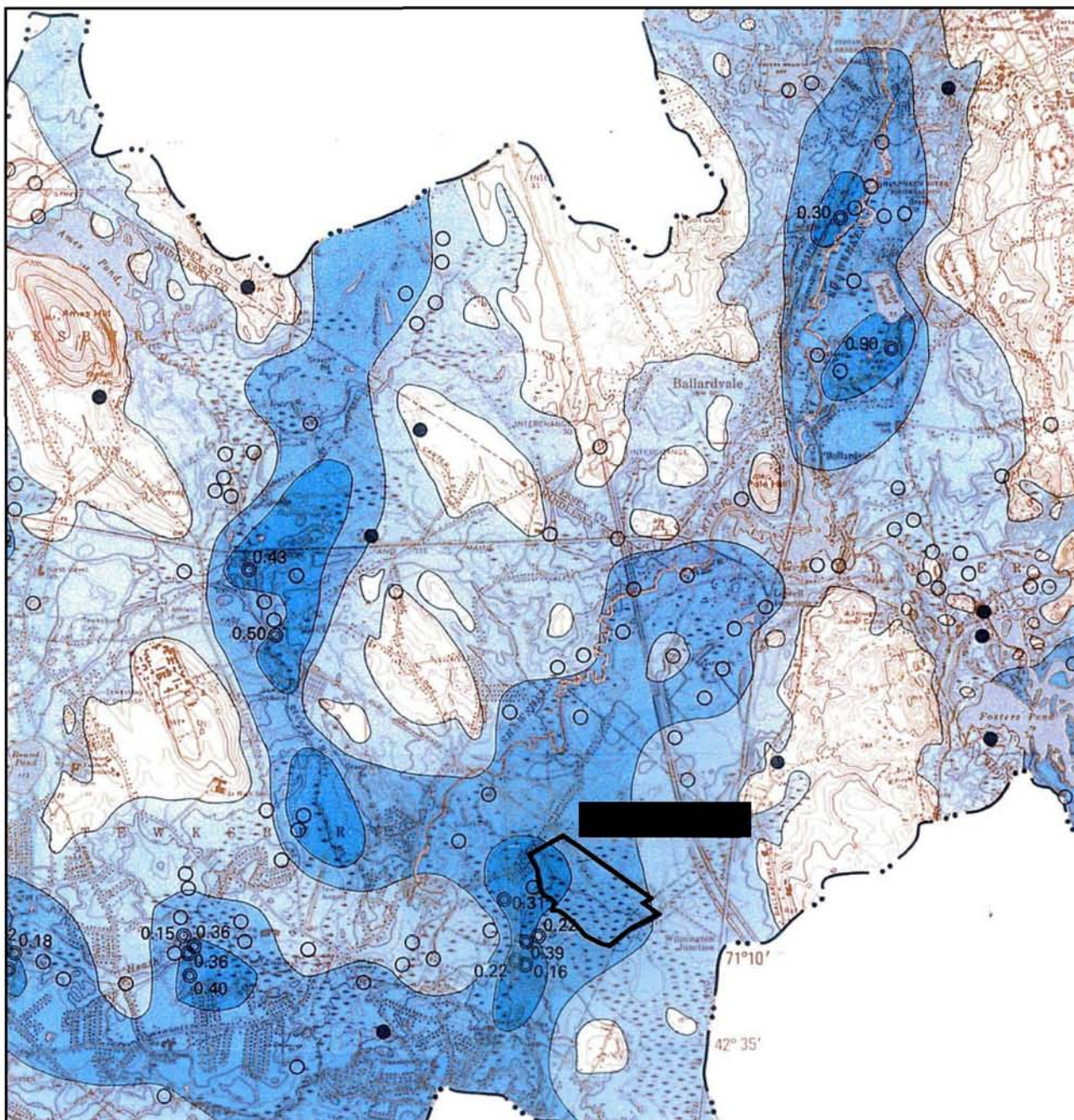
SUTTON BROOK DISPOSAL AREA

**APPROXIMATE CONFIGURATION OF
POTENTIOMETRIC SURFACE -
INTERMEDIATE OVERBURDEN
APRIL 20 & SEPTEMBER 19, 2005**

REV	DESCRIPTION	DATE
DESIGNED BY:	CHECKED BY:	
DRAWN BY: EVR	ANSBF-03 INT 4-9b.dwg	

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WELL DATA. NUMBER = PUMPING CAPACITY IN MILLION GALLONS PER DAY

TRANSMISSIVITY LESS THAN 1,400 TO 4,000 FT^2/D

TRANSMISSIVITY GREATER THAN 4,000 FT^2/D

DRAINAGE BASIN BOUNDARY

--- BASIN BOUNDARY

○ WELL OR BORING FINISHED IN UNCONSOLIDATED DEPOSITS

SOURCE: USGS HYDROLOGIC ATLAS SHAWSHOEN RIVER BASIN (USGS HA-614).



5. NATURE AND EXTENT

To facilitate the presentation and discussion of the nature and extent of contaminants, this section has been divided into the following sections:

- Landfill Lobes
- Former Drum Disposal Area and Adjacent Disturbed Area
- Former Residence, Garage, and Storage Area
- Sutton Brook and Associated Tributaries and Wetland Areas
- Reference Locations

These areas or data groups have also been organized for potential end use and/or exposure pathway or habitat evaluation, as discussed in the Risk Assessment. All data collected as part of the RI is presented in this section with the exception of groundwater. The groundwater data presented in this section was collected from 1995 to 2005 and does not include the pre-ROD groundwater data collected in 2006 as part of the seasonal variation and trend assessment nor the samples collected for MNA analyses in 2006. The 2006 groundwater data is presented in Section 6. All groundwater data has been incorporated into the baseline risk assessment. The specific data groups/areas and sample locations within each group are shown on Figure 5-0.

5.1 LANDFILL LOBES

As indicated previously, the solid waste disposal areas on the Site are configured into two separate and distinct lobes divided by Sutton Brook. These two lobes are referred to as the Northern Lobe and the Southern Lobe. The lobes received solid wastes from the late 1950s through the late 1980s. Historical information also indicated that the landfill was used for burning of waste prior to disposal.

A review of historical aerial photographs indicated that the site was largely undeveloped in 1938 (some trails were present in the area); by 1963, landfilling operations were present on the southeastern portion of the northern lobe (burning area) with support areas (trucks, cleared areas, and piles) adjacent to the Former Drum Disposal Area on the current portion of the Northern Lobe. The 1963 photograph also indicated that the southern lobe did not appear to be actively used for landfilling, although an access road was apparent. By 1978 both lobes were well established with the exception of the northern portions of the Northern Lobe, which appear to be the latest areas of landfilling.

Given the existing level of understanding and other supporting information regarding the landfill lobes, it is likely that a remedial action for the landfill lobes will be required. It has been presumed that both lobes of the landfill will be a capped; therefore, additional soil sampling within the limits of the landfill was not conducted during the RI. Additional sampling in support of remedial alternative evaluations (i.e., cap design) and to further delineate impacts to groundwater was conducted.

For presentation/discussion purposes, a boundary of this data group (Landfill Lobes) has been established, which includes the extent of the solid waste disposal areas (as determined during this investigation) as well as a “buffer” zone to accommodate: adjacent fill zones and debris piles; and potential work zones related to the remedial action, which includes the dirt access road on the eastern side of the northern lobe and the adjacent fill berm to this road (east of the road). It should also be noted that the brook proximate to the landfill lobes has been excluded from this data group (evaluated in Section 5.4) even though it has not been determined whether or not it may be included as part of the remedy.



The investigation of the landfill lobes consisted of the following data (all locations are shown on Figure 5-1a):

- Test pit excavations
 - Northern Lobe – 5 test pit excavations (2000) and 23 test pit excavations (2004) to determine the extent of the landfilled solid waste and adjacent debris piles
 - Southern Lobe – 14 test pit excavations (2004) to determine the extent of landfilled solid waste
- Upland soil samples
 - Northern Lobe – 7 soil samples for chemical characterization (1989) and 2 samples for physical characteristics (2004)
 - Southern Lobe – 2 soil samples for chemical characterization (1989) and 2 samples for physical characteristics (2004)
 - Adjacent to dirt access road, east of the Northern Lobe (Perkins Property) – 3 soil samples for chemical characterization (2002)
 - Adjacent to Southern Lobe but not within limits of waste – 2 soil samples for chemical characterization (1999 and 2004)
- Wetland soil samples collected from areas proximate to the lobes (see limits of data group shown on Figure 5-1a)
 - Northern Lobe – 3 soil samples for chemical characterization (1999 and 2004)
- Landfill gas
 - Northern Lobe – 6 samples for chemical characterization (1995 and 2004)
 - Southern Lobe – 2 samples for chemical characterization (2004)
 - Adjacent to the Northern Lobe – 3 locations for field analyses (2006)
- Ambient air on top of Lobes
 - Northern Lobe – 5 samples for chemical characterization (1992)
 - Southern Lobe – 1 sample for chemical characterization (1992)
- Groundwater
 - Northern Lobe – 15 wells proximate to lobe for chemical characterization (1995, 1999, 2002, 2004, and 2005 – not all wells sampled each event)
 - Southern Lobe – 13 wells proximate to lobe for chemical characterization (1995, 1999, 2001, 2004, and 2005 – not all wells sampled each event)
 - Both Lobes – additional groundwater samples were collected from select wells during the pre-ROD groundwater monitoring events (2005 and 2006)
- Leachate
 - Northern Lobe – 1 sample for chemical characterization (2005)
 - Southern Lobe – 1 sample for chemical characterization (2005)



The ground surface across both lobes is well-established with numerous types of vegetation cover and small groves of trees (see photograph to the right depicting the slope of the Northern Lobe). In some areas of the lobes, waste was present and/or observed protruding from the ground surface. The soil cover generally appears to be well-draining, with only a few standing water pockets/puddles observed during the RI (mostly in the area of 4x4 and vehicle trails across the top of the Southern Lobe). The current surface soils on both the Northern and Southern Lobes are brown, ranging from sand to silty-sand with trace organics and gravels dispersed throughout. The results of the physical characteristics analyses performed on the landfill cover soil samples indicated bulk densities ranging from 83.5 to 115 pcf with material comprised of 3.4 to 24.6% gravel, 56.8 to 86.1% sand, and 4.1 to 18.6% silt and clay.

Slope of Northern Landfill Lobe



The limits of the solid waste areas, determined from the test pit excavations, soil borings, and site reconnaissance activities, are shown on Figure 5-1b.

To approximate a volume of waste in the two landfill lobes, the following assumptions were applied:

- The bottom of the waste was assumed to be at or near the water table surface (as previously shown on the historic surficial geology map for the area [see Section 4], prior to the landfill the ground surface in the area of the landfill was wetland/swamp deposits).
- The area of the landfill as determined by the test pit excavations and shown on Figure 5-1b was 30 acres for the Northern Lobe and 10 acres for the Southern Lobe.
- The height of the waste was estimated as the ground surface elevation minus the top of the water table elevation (refer to Figure 4-9a and Figure 4-10a).

Based on these assumptions, the gross volume of material (solid waste and cover soil) is estimated at 1.9 million cubic yards for the Northern Lobe and 0.3 million cubic yards for the Southern Lobe for a total of 2.2 million cubic yards of material. As part of the RI, settlement monuments were established in 2004 (three on the Northern Lobe and two on the Southern Lobe) to assess settlement of the landfill with time.

As indicated on Figure 5-1b, in addition to the limits of the landfilled solid waste (e.g., lobes), there exists isolated, localized areas of debris/waste piles in five separate areas contiguous to and in proximity to the landfill lobes.

The primary migration pathways for contaminants from the landfill lobes include:

- infiltration/leaching of contaminants with subsequent transport via groundwater flow;
- soil erosion and wind blown transport of contaminants that are exposed at the surface, and includes both dust and surface water runoff; and
- volatile air emissions and transport.

For the following reasons groundwater contamination and migration is considered the primary migration pathway: 1) the uncapped/uncontained nature of the landfill does not limit infiltration and leaching; 2) wastes are most likely located at or near the water table surface; and 3) the proximity of Sutton Brook to the landfill lobes.



A discussion of the landfill lobes based on the RI data is presented in the following sections.

5.1.1 Northern Lobe

Of the two landfill lobes, the Northern Lobe is the largest at approximately 30 acres and rises to an elevation of approximately 170 feet (NAVD29), which corresponds to approximately 80 to 90 feet above the surrounding ground surface. As described above, the estimated gross volume of material contained within the landfill is 1.9 million cubic yards. The steepest areas of the Northern Lobe include the northern slope as it declines to the former railroad and the northwestern portion (most recent area of filling) where it declines to the Former Drum Disposal Area to the west and a pocketed wetland area to the southeast.

Based on the results of the landfill gas samples and field observations, the surface cover on the Northern Lobe varies from 2 feet (of mostly sand/silty-sand) to areas of minimum cover where waste is evident protruding from the surface. One such area is located at the southeastern corner of the Northern Lobe (near GP-2), where tires, household and other waste is at or just below the ground surface. The results from the test pit excavations confirmed the amount of cover material was relatively consistent (approximately 2 feet) and indicated that the edges of the Northern Lobe are comprised of typical household wastes; however, burnt waste/ash was observed on the northern portion of the northern lobe (as evident in test pits TP-1, TP-2, TP-3, TP-5, TP-12, TP-13, TP-15, and TP-16). Combined with the Southern Lobe (see Section 5.1.2), the landfill lobes constitute the primary source areas at the site.

The areas adjacent to the Northern Lobe include: the Perkins Development Trust property, north of the Northern Lobe and the former railroad; Sutton Brook and associated tributaries and wetlands to the east and south, and beyond that the Southern Lobe; and the Former Drum Disposal Area to the west.

As discussed in Section 4, Sutton Brook is the controlling hydrologic feature influencing groundwater flow at the Site. The groundwater flow patterns over three seasons have been mapped and are depicted in Figures 4-9a through 4-10b. As shown on these figures, groundwater flow patterns do not vary considerably between seasons, and are similar to regional patterns. Although localized mounding of ground water most likely occurs within the limits of the landfill, the overall groundwater flow direction across the Site is towards the brook. As such, groundwater flows westerly to southwesterly across the Northern Lobe.

As shown on Figure 5-1a, monitoring wells are located around the perimeter of each of the landfill lobes. Groundwater samples have been collected on several occasions from these wells (depending on their installation date), including a complete round of samples from each well collected in 2004 during Phase 1A RI activities and then again from a subset of wells during the pre-ROD Quarterly Monitoring and the Phase 1B RI sampling activities (refer to the Analytical Testing Summary tables, Tables 3-5 and 3-6 in Section 3). There are 15 monitoring wells along the perimeter of the Northern Lobe. A summary of the constituents detected in the groundwater samples from these wells is provided as Tables 5-1a (VOCs), 5-1b (SVOCs), 5-1c (Metals), 5-1d (other parameters). The complete data sets are provided in Appendix I.

As indicated on the summary tables, the primary constituents detected in the groundwater samples collected from around the Northern Lobe were VOCs and metals followed by SVOCs (several wells). A depiction of the total VOCs detected in groundwater from each of these wells is presented on Figure 5-1c. For relative consistency purposes, all data presented on this figure represents one sampling round, which was the data collection event conducted in October and November 2004. The exception to this condition is the data for PMW-2, which was collected in January 2005, and the data from WP-7, which was collected in December 2005.

As shown on Figure 5-1c, the groundwater data from the wells along the perimeter of the Northern Lobe were much lower in concentration (total VOCs ranged from 53 to 842 ug/l) than the Southern Lobe (total VOCs ranged from 3,450 to 57,210 ug/l, see Section below). The VOC generally detected at the highest



concentration in the wells along the Northern Lobe was either 1,4-dioxane or tetrahydrofuran. Also of note, is that the lowest concentrations of VOCs were detected in the upgradient wells installed along the dirt access road (Perkins Property wells). This overall configuration of the total VOCs supports the groundwater flow directions with flow in the direction of Sutton Brook.

Metals concentrations in groundwater detected from the Northern Lobe indicated that total arsenic was the most predominant metal detected, followed by cadmium and beryllium. Each of these metals was detected at concentrations above the MCLs on multiple sampling occasions. Lead was also detected above the MCL, however, not at the frequencies of the other metals. Sixteen other metals were also detected in groundwater samples at or near the Northern Lobe.

For those wells sampled multiple times, concentrations of VOCs, SVOCs and metals detected in groundwater showed relatively stable levels. As indicated in Section 4, groundwater flows westerly to southwesterly through the Northern Lobe and towards the brook. Similar constituents as detected in groundwater were also detected in surface water and sediment samples. The samples with the highest concentrations were detected in the stretch of Sutton Brook between the two lobes. A discussion of these sample results are presented in the section on Sutton Brook and Associated Tributaries and Wetlands (see Section 5.4).

As part of the initial investigation activities performed at the Site, soil samples from the Northern Lobe and immediate vicinity were collected for laboratory analysis. The analytical testing summary table for all soil samples collected and analyzed is presented in Section 3 (Table 3-4). Summary tables of the VOCs, SVOCs, Metals, and PCBs/pesticides detected in soil samples from the Northern Lobe are provided in Tables 5-1e through 5-1h, respectively. Complete data sets are provided in Appendix I.

The results of the surficial soil data (surface, upland, and wetland soils) collected within and around the Northern Lobe indicated: few detections of VOCs with BTEX being detected at the highest concentrations; a wide range of SVOCs detected at various concentrations, with PAHs being detected at the greatest frequency; few detections of PCBs and pesticides; and 18 different inorganic elements, detected at various concentrations (with higher concentrations of arsenic, chromium, and lead). In addition, TPH was detected in one sample (at 36 mg/kg) north of the dirt access road (from the Perkins Property).

The soil sample collected from the wetland east of the Northern Lobe (GP-1(04)) contained a range of inorganics and detected six VOCs, including low concentrations of benzene, toluene, ethyl benzene, and xylenes (BTEX). However, no SVOCs or PCBs/pesticides were detected. The two samples collected from the pocketed wetland area south of the Northern Lobe (SD-03(99) and SD-04(99)) indicated detection of PAHs and pesticides, and low concentrations of benzene and toluene.

5.1.2 Southern Lobe

The Southern Lobe, which is the smaller of the two lobes, comprises approximately 10 acres and rises to an elevation of approximately 110 feet (NAVD29), which is about 60 feet lower than the Northern Lobe's height. The Southern Lobe is flat across the top, with moderate slopes declining to the brook and the surrounding wetland areas. The estimated gross volume of the Southern Lobe is 0.3 million cubic yards. Similar to the Northern Lobe, the ground surface on the Southern Lobe generally consists of approximately 2 feet of cover material (mostly sand/silty-sand). There are select areas of little or no cover that include the southwestern corner between MW-4S/4B and GP-18 and also the area west of GP-9. Also, just as there are isolated debris piles that are adjacent to the Northern Lobe, there are areas of tires, scrap metal, and other solid waste located on the surface surrounding the Southern Lobe. The waste encountered in test pits excavated around the perimeter of the Southern Lobe indicated a mix of non-burnt household waste and other solid waste (plastic rolls, sheeting, wood, metal, concrete, etc.). The landfill lobes together represent the primary source areas at the site.



The areas adjacent to the Southern Lobe include: Sutton Brook and associated tributaries and wetlands to the north, east, and west; a wetland area to the southeast that separates the site from an on-going composting facility; and a forested wetland and wooded area to the south that also includes a shallow pond and dirt trails currently used by recreational vehicles.

As discussed in Section 4, Sutton Brook is the controlling hydrologic feature influencing groundwater flow at the Site. The groundwater flow patterns over three seasons have been mapped and are depicted in Figures 4-9a through 4-10b. As shown on these figures, groundwater flow patterns do not vary considerably between seasons, and are similar to regional patterns. Although localized mounding of ground water most likely occurs within the limits of the landfill, the overall groundwater flow direction across the Site is towards the brook. As such, groundwater flows northerly across the Southern Lobe.

As shown on Figure 5-1a, monitoring wells are located around the perimeter of each of the landfill lobes. There are 12 monitoring wells around the perimeter of the Southern Lobe. A summary of the constituents detected in groundwater samples from these wells (from multiple sampling events, see Tables 3-5 and 3-6 for the Analytical Testing Summary tables) is provided as Tables 5-1i (VOC), 5-1j (SVOC), 5-1k (Metals), 5-1l (other parameters). The complete data sets are provided in Appendix I.

Similar to the Northern Lobe, the primary constituents detected in the groundwater samples collected from around the Southern Lobe were VOCs and metals followed by SVOCs (several wells). However, unlike the Northern Lobe, these compounds were detected at much higher concentrations. Pesticides were also detected in MW-4B on one occasion.

Total VOC concentrations in these wells ranged from 3,450 to 57,210 ug/l (2004 data). The VOCs generally detected at the highest concentrations in the wells were toluene and tetrahydrofuran, although several ketones were found to be concentrated at high levels in the northwest corner of the Southern Lobe (MW-4S/4B and MW-5). Ketones were also a common constituent detected in the other wells along the northern perimeter of the Southern Lobe, adjacent to the brook. Concentrations of SVOCs were also detected in groundwater from the northwest corner of the lobe.

As shown on Figure 5-1c, the higher concentrations of VOCs were detected in the wells located adjacent to the western to northwestern sides (MW-4, GP-18, GP-14 through GP-16) and northeastern sides (GP-11 through GP-13) of the Southern Lobe relative to the eastern or southern sides (GP-10, GP-9, and WES-4, WED-5). This concentration distribution supports the northerly groundwater flow pattern across the Southern Lobe toward the brook. Concentrations of toluene, xylene, and ethyl benzene were detected in GP-9; however, this well is located proximate to the edge of waste and within a wetland area that is subject to localized groundwater discharge. This was also observed in groundwater samples collected from the wetland area to the southwest of the Southern Lobe (WP-7).

Metals concentrations in groundwater detected from the Southern Lobe indicated similar results to those of the Northern Lobe: total arsenic was the most predominant metal detected. Arsenic, beryllium, cadmium, and selenium were all detected above the MCL. Nineteen other metals were detected at various concentrations and frequencies from groundwater at or near the Southern Lobe.

For those wells sampled multiple times (MW-4S/4B and MW-5), concentrations of VOCs tended to be relatively stable. Concentrations of SVOCs and metals detected in groundwater were also relatively stable, with the exception of a few metal concentrations that seem to trend down (cobalt, manganese, nickel, and zinc).

The results of the surficial soil data collected within the Southern Lobe indicated a range of inorganics (16 separate metals), SVOCs (10 different compounds, primarily PAHs), and pesticides, but no detection of VOCs or PCBs.



Samples collected from areas adjacent the Southern Lobe also indicated a range of inorganics, one SVOC (bis (2-ethylhexyl) phthalate) and concentrations of 2 VOCs in one sample. No concentrations of dioxins were detected in SS-8(04), collected from the wetland area west of the Southern Lobe.

The analytical testing summary table for all soil samples collected and analyzed is presented in Section 3 (Table 3-4). Summary tables of the VOCs, SVOCs, Metals, and PCBs/pesticides detected in soil samples from the Southern Lobe are provided in Tables 5-1m through 5-1p, respectively. Complete data sets are provided in Appendix I.

5.1.3 Landfill Leachate

During the RI field activities, leachate areas on the ground surface were observed during periods of high water table conditions. During one of these conditions in April 2005, two leachate samples (LF-1 and LF-2) were collected from leachate areas identified at the landfill (see photographs below depicting both leachate areas). One sample (LF-1) was collected near MW-3S on the Northern Lobe and another was collected from the area between GP-15 and GP-16 on the Southern Lobe (refer to Figure 5-1a for locations). In both areas, there were no active seepages. However, the orange to rust colored stains on the ground surface represented former liquid areas, and in other areas, ponded water with the same rust to



Leachate from Northern Lobe



Leachate from Southern Lobe

orange color was still present. The water was also characterized by a translucent to rainbow sheen, with some emulsification and effervescence noted. The samples were collected from this ponded water and submitted for VOCs, SVOCs, PCBs/pesticides, and TAL Metals (see Analytical Testing Summary table, Table 3-11 in Section 3).

Tables 5-1q and 5-1r summarize the analytical results for VOCs/SVOCs and for metals, respectively. Complete data sets are included in Appendix I. Only benzene and acetone were detected in the sample from the Northern Lobe (LF-1), while 12 different VOCs/SVOCs were detected in the sample collected from the Southern Lobe. The constituent detected at the highest concentration was 3-Methylphenol/4-Methylphenol (910 ppm), which has been detected in site groundwater in this area. The detection of VOCs at greater concentrations in the Southern Lobe than the Northern Lobe is consistent with the groundwater data collected from those same areas (MW-4S/4B on the Southern Lobe compared to MW-3S/3B on the Northern Lobe). Metals were generally detected at lower concentrations in the sample collected from the Southern Lobe.



5.1.4 Landfill Gas and Ambient Air

To assess and characterize landfill gases generated from the landfill lobes, eight subsurface gas samples were collected for laboratory analyses. A summary of the landfill gas measurements from the both the Northern Lobe and the Southern Lobe is provided below.

Table 5-1s Landfill Gas Measurements

Sample Location	% methane by volume	% carbon dioxide by volume	% oxygen by volume	Hydrogen sulfide (ppm)	Total VOCs (ppm)
Northern Lobe					
LFG-1 (95)	36	NM	1.2	16	540
LFG-2 (95)	35	NM	0.8	75	97
LFG-3 (95)	38	NM	0.6	12	4
SG-1 (04)	14	15	7.6	0	2
SG-2 (04)	63	34	1.4	15	11
SG-3 (04)	30	24	5.8	0	0.7
Southern Lobe					
SG-4 (04)	70	30	0.5	48	539
SG-5 (04)	67	33	0.1	6	12
ppm = parts per million by volume					

In 2004, similar parameters were also measured in the wellhead space at each of the site's temporary and permanent monitoring wells (refer to Tables 2-4 and 2-5 in Section 2 for a presentation of the results). As part of the RI activities with regard to potential landfill gas migration along property boundaries, three soil gas points were installed approximately 650 linear feet away from one another along or near the property line adjacent to the northern edge of the Northern landfill lobe (along the dirt access road to the composting facility and farm) to assess landfill gas generation and migration in this direction.

The newly installed soil gas probes (SG-6, SG-7, and SG-8) and existing monitoring wells PMW-1, PMW-2, PMW-3, and/or PMW-6 were monitored for methane (% volume and %LEL), hydrogen sulfide, oxygen, and/or carbon dioxide.

The landfill gas monitoring was performed on December 11, 2006 following the installation of the new soil gas probes, and again on January 22 and 23, 2007, when the ground was frozen and the barometric pressure was dropping (i.e. storm front approaching). This represents maximum potential for landfill gas migration with the landfill gas pressure being greater than atmospheric pressure.

The following table presents the summary of results of the landfill soil monitoring:



Table 5-1t Perimeter Landfill Gas Measurements

Sample Location	Date	% methane by volume	Hydrogen sulfide (ppm)	% oxygen by volume	% carbon dioxide by volume
SG-6	12/11/06	0.0	--	20.6	0.1
	1/22/07	41.4	12	0.0	30.4
	1/23/07	50.6	12	0.0	31.6
SG-7	12/11/06	0.1	--	20.5	0.1
	1/22/07	0.4	0	8.2	4.1
	1/23/07	1.0	0	8.6	4.9
SG-8	12/11/06	0.0	--	20.3	0.1
	1/22/07	0.1	0	22.7	0.1
	1/23/07*	0.4	0	21.5	0.2
PMW-1	11/23/04	0.0	0	19.0	0
	12/11/06	0.0	--	20.7	0.2
	1/23/07*	0.3	0	21.2	1.6
PMW-2	11/23/04	0	0	20.3	0
	12/11/06	0.1	--	20.4	0.1
	1/23/07	6.5	0	14.2	5.4
PMW-3	11/23/04	0.0	0	19.6	0
	12/11/06	0.0	--	20.5	0.1
	1/23/07	0.7	0	21.4	0.9
PMW-6	11/23/04	0.1	0	19.0	0
	1/23/07*	0.2	0	21.7	0.2

Notes:

Values entered represent peak values (lowest %oxygen, highest for all other parameters)

* = Methane values recorded were similar to ambient/background values.

Readings taken in January 2007 occurred in frozen ground and falling barometric pressure conditions.

The soil gas measurements collected on December 11, 2006 showed stable readings for methane, oxygen, and carbon dioxide from each of the six monitoring points (SG-6 through SG-8 and PMW-1 through PMW-3). Measurements collected on January 22, 2007 were recorded at SG-6, SG-7, and SG-8 under frozen ground and falling barometric pressure conditions. Higher levels of methane were recorded during the January event compared to the previous rounds. Levels of oxygen and carbon dioxide recorded in SG-8 were comparable to the measurements collected on December 11, 2006; however, increased carbon dioxide and decreased oxygen levels were recorded at SG-7 and SG-6. Hydrogen sulfide was detected at SG-6 at 12 ppm and non-detect at the other two points. A second round of soil gas monitoring was conducted on January 23, 2007 at SG-6 through SG-8, PMW-1 through PMW-3, and PMW-6 under similar conditions as the day before (i.e., frozen ground and reduced barometric pressure) and confirmed these readings.

The extent of methane and carbon dioxide detected in the landfill gas (soil probe samples) and wellhead spaces of the wells installed along the perimeter of the landfill is presented on Figure 5-1d. As indicated on this figure, the concentrations of methane and carbon dioxide were lower and more variable across the Northern Lobe with isolated increases along the perimeter (southeastern and northwestern portion of the lobes), while methane and carbon dioxide were steady across the Southern Lobe with increases in well headspace readings on the northern perimeter of the lobe. These data will be used in the FS to aid in evaluating the remedy with respect to gas collection systems.

As indicated in Table 5-1s, the highest concentrations of VOCs were detected in LFG-1 (Northern Lobe) and SG-4 (Southern Lobe). The specific VOCs detected in each of these samples at the highest



concentrations were trichlorofluoromethane (260 ppm), dichlorodifluoromethane (210 ppm) and toluene (35 ppm) in LFG-1 and toluene (301 ppm), cis-1,2 DCE (56.3 ppm), dichlorodifluoromethane (37.6 ppm), vinyl chloride (34.9 ppm), and n-hexane (32.9 ppm) in SG-4. The VOCs detected at the greatest frequency in all samples were toluene, xylene, n-hexane, ethylbenzene, and dichlorodifluoromethane. The complete data set is included in Appendix I.

To assess potential air emissions from the uncapped landfill, EPA performed a quantitative air study consisting of eight 2-hour canister grab samples from areas on the landfill where EPA observed leachate or eroding areas and/or detected odors. Although this data was collected in 1992, it was considered in the evaluation because landfill gas generation is likely to be either steady-state or decreasing over time. The sampling locations are shown on Figure 5-1a.

Low parts per billion concentrations of several VOCs were detected in only two of the seven samples (both on the northern lobe). Given the existing data set, the landfill gas data, and a likely cap as part of the remedy, additional ambient air samples were not collected during this RI. This migration and exposure pathway is discussed and evaluated in Section 6 (Fate and Transport) and the baseline risk assessment.

5.1.5 Landfill Lobes - Summary

Based on the investigation activities conducted in the area immediately surrounding the landfill lobes, the following findings are provided:

- Of the two landfill lobes, the Northern Lobe is the largest at approximately 30 acres (1.9 million cubic yards of material) and the Southern Lobe, which is the smaller of the two lobes, comprises approximately 10 acres (0.3 million cubic yards of material). Localized debris/waste piles have been identified in five areas proximate to the landfill lobes.
- Groundwater migration is the primary contaminant migration pathway away from the lobes based on: 1) the uncapped/uncontained nature of the landfill does not limit infiltration and subsequent leaching; 2) wastes are most likely located at or near the water table surface; and 3) the proximity of Sutton Brook to the landfill lobes.
- Although localized mounding of ground water most likely occurs within the limits of the landfill, the overall groundwater flow direction is towards the brook.
- The primary constituents detected in the groundwater samples were VOCs and metals followed by SVOCs (several wells) and one pesticide. The highest concentrations of VOCs were detected in the wells located adjacent to the northwestern and northeastern sides of the Southern Lobe. Total VOC concentrations in these wells ranged from 3,450 to 57,210 ug/l. The VOC generally detected at the highest concentration in the wells was toluene.
- The groundwater data from the wells along the perimeter of the Northern Lobe were much lower in concentration (total VOCs ranged from 53 to 842 ug/l). Unlike the Southern Lobe, the VOC generally detected at the highest concentration in the wells was either 1,4-dioxane or tetrahydrofuran. The lowest concentrations of VOCs were detected in the upgradient wells installed along the dirt access road (Perkins Property wells). This overall configuration of the total VOCs supports the groundwater flow directions with flow in the direction of Sutton Brook.
- Similar constituents as detected in groundwater were also detected in surface water and sediment samples. The samples with the highest concentrations were detected in the stretch of Sutton Brook which traverses in between the two lobes (see Section 5-4).



- Similar constituents as detected in groundwater were also detected in leachate samples collected from both the Northern and Southern Lobes. The highest total VOCs were detected from the leachate area identified near MW-4S/4B on the northwest corner of the Southern Lobe.
- Landfill gases generated from the two lobes ranged from 14 to 70 % methane; 15 to 34% carbon dioxide; and 0.7 to 540 ppm total VOCs. These levels are generally consistent with other New England landfills of this size. The VOCs detected at the greatest frequency in the samples were toluene, ethyl benzene, n-hexane, and dichlorodifluoromethane.
- Potential air emissions from the uncapped landfill were evaluated by ambient air samples. Results indicated low parts per billion concentrations of several VOCs were detected in only two of the seven samples (only on the Northern Lobe).

The discussion of the investigation of the brook and the wetlands is presented collectively in Section 5.4. In addition, an overall assessment and presentation of site-wide groundwater is presented in Sections 5.5, while the Fate and Transport of contaminants is discussed in Section 6.

5.2 FORMER DRUM DISPOSAL AREA AND ADJACENT DISTURBED AREA

This area is located on the northwest portion of the Site and consists of two areas referred to as the: 1) Former Drum Disposal Area; and 2) Adjacent Disturbed Area. As shown on Figure 5-2a, the adjacent disturbed area is almost totally comprised of a wetland area. This wetland area was most likely created as a result of topsoil removal and equipment compaction (as evidenced by the exposed soil cuts on the limits of the area and presence of sand and gravel on the surface).

A description of the remedial investigation activities conducted in this area of the site and a discussion of the nature and extent of contaminants in these areas is presented in the following paragraphs.

5.2.1 Former Drum Disposal Area

The Former Drum Disposal Area was initially identified in 1999 during a magnetic survey and test pitting program completed as part of a site investigation conducted by the MassDEP and EPA. During this investigation, 11 soil samples collected by IT Corporation (for MassDEP) in May/June 1999 and 53 soil samples collected by EPA in August 1999 indicated the presence of elevated levels of VOCs and SVOCs as well as numerous crushed drums/containers. The 1999 soil data indicated that releases of chlorinated VOCs (1,1-DCA, PCE, TCE, 1,1,1-TCA) and non-chlorinated VOCs (toluene and xylene) and, to a lesser extent, SVOCs occurred to soils in this area. An average concentration of total VOCs of 17,000 ppm was detected in soils across this area. The majority of the drums/containers were located on the southeast portion of this area.

In 2000, EPA conducted a removal action in which approximately 300 to 400 crushed drums were excavated and disposed off-site. As part of the excavation, 13,786 tons of soil was transported off-site for disposal. Following the removal program, 154 soil samples were collected from the base or perimeter of the excavation areas and field screened with an on-site gas chromatograph. In addition, 20 samples were submitted to an off-site laboratory for confirmatory analyses. The locations of these samples are shown on Figure 5-2a. The locations of six of these samples are not shown on this figure given that they were not shown on the Weston March 2002 report drawing; however, these six samples do not represent locations of higher VOC concentrations.

A summary of the results from these 20 samples is presented on Table 5-2a. The results indicated that residual levels of VOCs (benzene, TCE, toluene, PCE, ethylbenzene, and xylenes) are present in soils with toluene, ethylbenzene, and xylenes exhibiting the highest concentrations and greatest frequency of detection. The highest total VOC concentration was detected in sample SS-104 (68,818 mg/kg) located on the southeast portion of the area.



Based on a visual inspection of this area, there appears to have been some backfilling of portions of the excavated area. The Weston March 2002 report references 18 loads of fill and two loads of crushed stone being delivered to the site. There is also a reference to backfilling portions of the drum area; however, this pre-dates the fill material delivery. Low points still remain in this area relative to the surrounding ground surface.

In October 2004, six soil borings (SB-1 through SB-6) were advanced within this area to further aid in delineating the nature and extent of the residual contamination (see Figure 5-2a for their locations). One sample from each boring was analyzed by the laboratory for VOCs, SVOCs, metals, PCBs, and pesticides. The sample from each boring that exhibited the highest soil jar headspace measurement with the total VOC analyzer was submitted to the laboratory for VOC analyses. Summary tables of the detected parameters are presented as Tables 5-2b (VOCs), 5-2c (SVOCs), and 5-2d (metals). No concentrations of PCBs or pesticides above the laboratory's minimum reporting limit were detected in the samples. The complete analytical results are provided in the Appendix I tables.

As indicated on these tables, VOCs were detected at the greatest frequency and concentrations. The VOCs were primarily comprised of purgeable aromatic hydrocarbons (ethylbenzene, toluene, xylenes, trimethylbenzenes, etc.). In addition, elevated concentrations of two chlorinated VOCs (1,1,1-TCA and PCE) were detected in the sample from boring SB-6 (which also exhibited the highest total VOC concentration).

Concentrations of the SVOCs bis(2-ethylhexyl)phthalate, di-n-octylphthalate, and naphthalene were detected in each of the samples except the sample collected from SB-2(04). Additional SVOCs were also detected in the sample from SB-1(04). Similar to the VOCs in soils, the highest concentrations of SVOCs were also detected in the southeast portion of this area. Metals were detected in each of the soil samples with iron, aluminum, and magnesium being detected at the highest concentrations.

A depiction of the total VOC concentrations in soils in this area is presented as Figure 5-2b. For comparison purposes with the 20 post-excavation samples (in which only selective VOCs were reported), concentrations of xylenes are also presented and plotted on this figure. As shown on Figure 5-2b, the highest concentrations of residual VOCs are present on the southeast portion of the area, which corresponds to the area where more of the drums were located.

During borehole advancement, continuous soil samples were collected and soil jar headspace measurements were obtained using a total VOC analyzer. Vertical profiles of the jar headspace measurements with depth for the four soil borings on the southeast portion of the area are presented as Figure 5-2c. As shown on this figure, the highest concentrations of VOCs were detected at or just above the water table surface (4 to 6 feet below current grade) and decreased with depth.

As indicated above, an extensive source removal action has been completed within this area; however, elevated residual concentrations of contaminants remain in shallow soils at or near the water table surface. Assuming an area of approximately 31,000 square feet (area corresponding to total VOCs > 100 mg/kg – see Figure 5-2b) and a vertical thickness of 6 feet, approximately 7,000 cubic yards of residually VOC impacted soil is estimated to remain in this area.

The primary migration pathways for these residual contaminants from the Former Drum Disposal Area are infiltration/leaching and groundwater flow. In addition, soil erosion and volatile air emissions are potential migration pathways for contaminants that may be exposed or migrate to the surface. However, as indicated above, the highest concentrations of contaminants are not located on the current ground surface.

To assess impacts to groundwater from this area, a network of monitoring wells have been installed immediately adjacent to and downgradient of this area. As indicated on the Analytical Testing Summary tables presented in Section 3, several rounds of groundwater samples have been collected from the wells in this area and analyzed for VOCs, SVOCs, metals, cyanide, PCBs, pesticides, petroleum hydrocarbons,



and general chemistry and monitored natural attenuation parameters. A summary of the constituents detected in groundwater from all sampling dates from the “source area” wells is presented on Table 5-2e (VOCs), 5-2f (SVOCs), 5-2g (metals), and 5-2h (petroleum hydrocarbons). To aid in the Feasibility Study, groundwater samples from select wells were also collected for monitored natural attenuation and general wet chemistry parameters. The complete analytical results are provided in the Appendix I tables. A discussion on the groundwater results from the downgradient wells to this area is also presented below. A more detailed discussion of groundwater across the entire site, incorporating the different source areas and all monitoring wells, is presented in Section 5.5.

As indicated on Table 5-2e, VOCs were the primary constituents detected in the groundwater samples. Several SVOCs were detected with phenols and benzoic acid being detected at the highest concentrations. The majority of the SVOCs detected were listed as tentatively identified compounds. Petroleum hydrocarbons were analyzed for in three samples and detected in two of the samples (DEP-2 and MW-7M). No concentrations of PCBs or pesticides were detected in any of the samples. Metals were detected in the majority of the groundwater samples with elevated (relative to other metals) concentrations of arsenic, barium, iron, and zinc.

The highest concentrations of VOCs were detected in MW-9 and MW-7M which are located immediately adjacent to the southern portion of the former drum disposal area and area of highest residual soil concentrations. The specific VOCs detected at the highest concentrations were 4-methyl-2-pentanone, 2-butanone, and acetone; although all three compounds were only detected in MW-9. The VOCs detected most frequently in all wells were benzene, toluene, ethyl benzene and xylenes (BTEX) (similar to soils) and lower concentrations of 1,1,1-TCA, TCE, and 1,1-DCA.

A figure depicting the total VOC concentrations, total BTEX concentration, and total TCA, TCE, and DCA concentration detected in groundwater from each well is presented as Figure 5-2d. The most complete round of groundwater and surface water data from all wells and locations (the November – December 2004) is presented on this figure, except if a well was not installed at this time, then the most recent data from that specific well was used. The two microwells installed and sampled in 1999 (DEP-1 and -3) were not included on this figure given that they either could not be located, they were deemed non-viable for future monitoring given their limited size and access, the depths of the samples could not be obtained, and the figure represented 2004 or later data. These microwells are all proximate to existing well locations (MW-9, MW-10, GP-23, MW-7 triplet) that are being presented and evaluated in this section. The 1999 data from these microwells did not indicate a change in the nature or extent of contaminants from the former drum disposal area as presented in this section.

The figure also includes the USGS passive vapor diffusion (PVD) survey results, surface water data, and the December 2005 groundwater contours for the intermediate wells (well screens representing higher VOC concentrations). To provide further information in this area, a cross-section from the former drum disposal area through the Sutton Brook/wetlands area and into the residential neighborhood on the west side of the brook, is also included on this figure.

As indicated on this figure, groundwater on either sides of the brook and wetland areas flows east or west, respectively towards the brook and wetlands. There is also a northerly component flow that parallels the flow of the brook. This flow regime results in a net northerly groundwater flow pattern in this area. The potentiometric data also indicates that on the east side of the brook (wetland area) there is an upward component of flow; whereas on the west side of the brook, there is a downward component of flow off the bedrock high until groundwater reaches the wetlands/brook.

As presented in Section 4, the horizontal hydraulic gradients are relatively flat (0.001 ft/ft range), especially in the intermediate overburden (area of higher groundwater contamination) as groundwater approaches the wetlands/brook. These low gradients result in a reduced groundwater velocity and subsequent contaminant migration rates. The groundwater flow patterns and discharge areas have a direct influence on the migration potential and extent of the dissolved VOC plume in groundwater.



As the plume approaches the brook and wetlands, a component of the plume discharges into the brook/wetlands via groundwater flow. This is supported by the well point data, which suggests an upward component of flow from shallow groundwater to surface water at one of the locations (WP-9). The laboratory analytical results from shallow groundwater data also support these findings with elevated concentrations of VOCs detected in shallow groundwater (2 feet below the wetland sediment surface – refer to WP-9, 1,254 ug/l total VOCs). The VOCs detected in the shallow groundwater were comprised of purgeable aromatic VOCs (BTEX, trimethylbenzenes, propylbenzenes, etc.), THF, 1,4-dioxane, and some chlorinated VOCs (chloroethane).

Further supporting evidence of groundwater discharge includes the results of sediment samples, surface water samples, and the USGS PVD Study. Similar to groundwater, the VOCs detected in the sediment sample were primarily comprised of purgeable aromatic VOCs (BTEX, trimethylbenzenes, etc.), THF, and some chlorinated VOCs (cis-1,2 DCE, chloroethane). Similar to the groundwater and sediment, the VOCs detected in the surface water sample were primarily comprised of purgeable aromatic VOCs (BTEX, trimethylbenzenes, etc.), THF, and some chlorinated VOCs (1,1-DCA and TCA). Although, the higher concentrations of these compounds were detected further upstream (SW-34, near the northern end of the Southern Lobe and SW-35 further downstream of the Southern Lobe) and decrease with distance downstream. These concentrations are most likely attributable to the releases from the Southern Lobe.

Although the PVD survey only detected chlorinated VOCs (mainly TCE) in this area, the supplemental data collected during the RI indicates that similar types of compounds as detected in the former drum disposal area were also detected in the adjacent wetland area.

The highest concentrations of VOCs were found to be located at an intermediate depth within the upper aquifer and within a medium to fine sand layer. The chemical “signature” of constituents in wells MW-7M, MW-9, MW-8M, and MW-11 is similar, suggesting a direct groundwater path from the Former Drum Disposal Area. To assess the downgradient extent of the plume (in the northerly direction), several wells were installed and screened across similar depths as that of MW-9 and MW-7M. These wells included MW-10, GP-23, and GP-24. As shown on Figure 5-2d, non-detect to low concentrations of VOCs were detected in groundwater samples from these wells.

Groundwater contaminant migration on the west side of the brook in the area of the residential neighborhood is not expected given regional and local groundwater flow patterns. The four wells installed in this neighborhood were non-detect for site VOCs. As shown on Figure 5-2d, lower concentrations of some VOCs were detected in groundwater from some wells located on the west side and immediately adjacent to the brook and wetlands (MW-17 triplet, MW-13 triplet). These concentrations may be attributable to the net northerly direction of groundwater flow and contaminant transport as well as seasonal variations in flow paths immediately adjacent to the wetlands/brook.

Groundwater contamination has also been detected in wells located further to the southwest from the former drum disposal area (MW-22M – on the west side of the brook). However, these wells, as well as surface water and sediments within the brook and associated wetlands, have been impacted from releases associated with the upgradient landfill lobes, specifically the Southern Lobe.

The groundwater data also indicates that contamination is limited to the overburden and has not migrated into the bedrock aquifer. The bedrock wells MW-7R and MW-8R, directly downgradient of the area were non-detect for VOCs.

Natural attenuation/degradation in this area may also be contributing to the current nature and extent of the contaminants in groundwater. A preliminary review of natural attenuation conditions indicates that several conditions are favorable in this area to support the degradation of contaminants. For example, groundwater in this area is under reducing conditions and samples from MW-7M exhibited elevated sulfide, dissolved organic carbon, ferrous iron, and dissolved methane in comparison to other site wells.



A detailed discussion of these conditions is presented in the area-wide groundwater discussion (Section 5.5) as well as the contaminant fate and transport section (Section 6 of this report).

A summary of the principal RI findings is presented below:

- A removal action was conducted in this area by EPA in 2000, in which approximately 300 to 400 crushed drums were excavated and 13,786 tons of soil was transported off-site for disposal. Post-excavation data indicates that residual levels of VOCs (benzene, TCE, toluene, PCE, ethyl benzene, trimethylbenzenes, and xylenes) and SVOCs (bis(2-ethylhexyl)phthalate, di-n-octylphthalate, and naphthalene) are present in soils. The highest concentrations of VOCs and SVOCs were detected at or just above the water table surface (4 to 6 feet below current grade) and decreased with depth. The highest total VOC and SVOC concentration was detected in samples located on the southeast portion of the area. Approximately 7,000 cubic yards of residually impacted soil is estimated to remain in this area.
- The primary migration pathways for these residual contaminants are infiltration/leaching with subsequent transport via groundwater flow. In addition, soil erosion and volatile air emissions are potential migration pathways for contaminants that may be exposed or migrate to the surface. However, the highest concentrations of contaminants are not located at the ground surface.
- Similar to soils, VOCs were the primary constituents detected in the groundwater samples with benzene, toluene, ethyl benzene and xylenes (BTEX) and lower concentrations of 1,1,1-TCA, TCE, and 1,1-DCA being detected at the greatest frequency. Elevated concentrations of 4-methyl-2-pentanone, 2-butanone, and phenols were also detected in groundwater proximate to the area of the former drum disposal.
- The dissolved VOC concentrations in groundwater were found to be decreasing with distance from this source area. The highest concentrations of VOCs are migrating at an intermediate depth within the overburden aquifer and within a low conductivity medium to fine sand layer. The groundwater data also indicates that impact is limited to the overburden and has not migrated into the bedrock aquifer.
- The groundwater flow patterns and the presence of conditions amenable to natural degradation appear to be the controlling factors to the nature and extent of the groundwater contamination in this area. Groundwater on either sides of the brook and wetland areas flows east or west, respectively towards the brook and wetlands. There is also a northerly component flow that parallels the flow of the brook. This flow regime results in a net northerly groundwater flow pattern in this area. The horizontal hydraulic gradients are relatively flat, especially in the intermediate overburden (area of higher groundwater contamination) as groundwater approaches the wetlands/brook. These low gradients combined with low hydraulic conductivity result in a reduced groundwater velocity and subsequent contaminant migration rates. As the groundwater plume approaches Sutton Brook, a portion of the plume discharges into the brook/wetlands area. This is evident from the potentiometric heads of the wells; groundwater samples from shallow well points in this area; sediment and surface water samples with similar compounds to those detected in shallow groundwater; and the lower concentrations and type(s) of VOCs in hydraulically downgradient wells.

5.2.2 Adjacent Disturbed Area

As indicated above, the adjacent disturbed area is almost totally comprised of a wetland. This wetland was most likely created as a result of topsoil removal and equipment compaction (as evidenced by the exposed soil cuts on the limits of the area and presence of sand and gravel on the surface). The perimeter of this wetland is an upland forested area that acts as a berm to the wetland.



Prior to the RI, no soil samples had been collected in this area. As a result, four surficial soil samples (GP-23, SS-12, SS-13, and SS-14) spatially distributed in this area were collected and submitted for laboratory analyses. The locations of the four soil samples are shown on Figure 5-2a.

Each surficial soil sample was analyzed by the laboratory for VOCs, SVOCs, metals, PCBs, pesticides, TOC, and pH. Summary tables of the detected parameters in soil are presented as Tables 5-2i (VOCs and SVOCs), 5-2j (metals), 5-2k (pesticides), and 5-2l (TOC and pH). The complete analytical results are provided in Appendix I. No concentrations of PCBs above the laboratory's minimum reporting limit were detected in the soil samples.

As indicated on the tables, low concentrations of four VOCs, one SVOC, and three pesticides (one sample only – SS-13) were detected in the soil samples. Concentrations of metals were detected in each of the samples with the metals detected in sample SS-14 were generally higher than the remainder of the data set.

Primarily to delineate the extent of groundwater impacts from the Former Drum Disposal Area, three temporary wells (GP-23, GP-24, and GP-25) were installed to complement the existing monitoring wells previously installed in this area (MW-10, MW-16D, MW-16B, and microwell DEP-1). The locations of the wells are shown on Figure 5-2a.

Groundwater samples from each temporary well were analyzed by the laboratory for VOCs, 1,4-dioxane, select metals, and hardness. Groundwater from the existing wells, with the exception of DEP-1 due to well accessibility issues, was also sampled for VOCs, SVOCs, PCBs, pesticides, and metals. Summary tables of the detected parameters in groundwater are presented as Tables 5-2m (VOCs), 5-2n (SVOCs), 5-2o (PCBs and pesticides), and 5-2p (metals and hardness). The complete analytical results are provided in Appendix I.

Several VOCs were detected in the groundwater samples with the highest concentrations detected in upgradient well GP-25. The compounds 1,4-dioxane and tetrahydrofuran were detected at the highest concentrations in the sample. This well is located downgradient of the landfill. Only an estimated concentration of naphthalene (0.49 ug/l) was detected in the SVOC analyses. A concentration of 1.2 ug/l of Aroclor 1254 was detected in the sample from MW-16D. Concentrations of metals were detected in the majority of the samples with the highest concentrations being detected in the deeper overburden and bedrock well couplet, MW-16D and MW-16B.

In addition to the soil and groundwater sampling data, one surface water sample was collected from the standing water in the aquatic wetland in support of the evaluation of this habitat in the ecological risk assessment (see Figure 5-2a). The sample was analyzed for VOCs, total and dissolved metals, nitrate, sulfate, and hardness. The results indicated that low concentrations of acetone, 1,4-dioxane, and metals were detected in the sample. A full discussion and evaluation of this sample, as well as all the data from this area, is provided in the risk assessment.

Based on the investigation activities conducted in the “disturbed” area adjacent to the Former Drum Disposal Area, there is not a significant release of contaminants within this area. Low concentrations of some VOCs consistently detected across the site have been detected in groundwater from this area. A more detailed discussion of site-wide groundwater is presented in Section 5.5.

5.3 FORMER RESIDENCE, GARAGE, AND STORAGE AREA

This area is located on the northern most portion of the Site and primarily consists of two structures (a former residence and garage of the Rocco family) and open storage space (see photo below). The majority of the area contains surficial debris from past dumping and storage activities. This area is bordered by a residential area to the north, a tributary to Sutton Brook and associated wetland areas to the west and south and Krochmal Farm to the east (see Figure 5-3a).



In general, the topography of the area is flat, although manmade berms of sandy fill material are present along the southeastern portion of the area. These berms may have been intended to act as a buffer between this area and the northern access road.

As shown on Figure 5-3a, two unpaved driveways/access roads (originating from South Street) make up the northeastern boundary of this area. The southernmost driveway provides the primary means of access to the former residence and garage and was a former access way to the landfill. The northernmost driveway is a well-maintained sand and gravel road that was a former railroad bed and is currently used as the main access road to the off-site composting facility and farm south of the Site.



Former Residence, Garage and Storage Area

In addition to providing landfill operation support, this area was also used for a loam screening business (1980s to early 1990s) and construction equipment storage by an off-site construction company (1990's).

As part of observations made during the current RI activities, this area continues to be used for storage and maintenance of construction vehicles. Given that the former residence is abandoned and the area is isolated from South Street, dumping of trash and debris (abandoned vehicles, boats, piles of trash and miscellaneous construction debris) was observed on the surrounding adjacent areas of the property.

Currently, there continues to be equipment storage in this area consisting of: storage trailers, dump truck vehicles, snow plows, and general construction equipment. Surficial debris in discrete piles across this area is also present and includes, but is not limited to: lead acid batteries, tires, gas cylinders, empty above ground storage tanks, empty drums/containers, metal debris, concrete, and wood (see photo to the right for a current depiction of a typical pile). In addition, surficially stained soils were visually identified in some areas.



Soil/Debris Pile – South of the Garage

A description of the remedial investigation activities conducted in this area of the site and a discussion of the nature and extent of contaminants in this area are presented in the following paragraphs.

Beginning in May 1999, the MassDEP conducted a magnetometer survey which resulted in two anomalies recorded in the area adjacent to the wetland area. Two test pits (ITTP-9 and ITTP-10) were excavated to investigate these anomalies (refer to Figure 5-3a).

Test pit ITTP-9 encountered fill material consisting of metal debris, a thin layer of household waste, and glass to a depth of 10 feet below ground surface. No elevated PID field screening measurements were observed and native soils were encountered from 10 to 15 feet below ground surface. Test pit ITTP-10



indicated construction debris, wood and metal in the upper 10 feet. Groundwater was encountered at 6 feet below ground surface. The fill material and debris extended into the water table. This test pit is located adjacent to the current wetland area and may be associated with filling of this wetland area.

Following the test pit excavations, the MassDEP and EPA conducted additional investigation activities in August 1999. During this investigation phase, nine surficial soil samples (SO-01, SO-02, and SO-04 through SO-10 – all collected from 0 to 0.5 ft) were collected and analyzed at the laboratory for VOCs, SVOCs, PCBs, pesticides, metals (including cyanide) and petroleum hydrocarbons. An additional subsurface soil sample (15-17 ft bgs) was collected during the installation of monitoring well WED-7 (see Figure 5-3a for the sample locations).

Summary tables of the detected parameters in soil are presented as Tables 5-3a (VOCs), 5-3b (SVOCs), 5-3c (metals), 5-3d (PCBs and pesticides), and 5-3e (petroleum hydrocarbons). The complete analytical results are presented in Appendix I of this Report. The results indicated that low levels of VOCs (acetone, benzene, toluene, 2-butanone, carbon disulfide, 1,2,4-trichlorobenzene, ethylbenzene, and xylenes) were detected in eight of the ten soil samples. Soil samples SO-01 (located on north side of residence) and SO-06 (located in open area south of the garage) did not contain detectable levels of VOCs. The highest total VOC concentration was detected in sample SO-09 located on the southern portion of the area.

SVOC concentrations were detected in each of the samples with the exception of SO-02 (located adjacent the south side of the residence). The highest concentrations of SVOCs were generally detected in samples located within the storage area (SO-07 through SO-10) with the highest concentrations detected in sample SO-07 (11,630 ug/kg total SVOCs). The predominant constituents detected were the polynuclear aromatic hydrocarbons (PAHs). The predominant PAHs detected in soil were bis(2-ethylhexyl)phthalate, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, fluoranthene, pyrene, chrysene, phenanthrene, indeno(1,2,3-cd)pyrene, and anthracene.

Concentrations of inorganic compounds were detected in each of the ten soil samples submitted to the laboratory for analysis. The reported concentrations for the nine surficial soil samples were generally elevated relative to the deeper subsurface sample collected at WED-7.

The majority of the metals analyzed for were detected in each sample, although concentrations of selenium, thallium and mercury were not detected in any of the samples and concentrations of arsenic and cadmium were detected with less frequency.

Low concentrations of PCBs were detected in 8 of the 9 surficial samples analyzed and were not detected in the subsurface soil sample collected from WED-7. Aroclor 1248 was detected in 5 samples and Aroclor 1260 was detected in 8 samples. Concentrations ranged from 0.012 to 0.11 mg/kg. No concentrations of PCBs were detected in sample SO-02 (located adjacent to the residence). The results of the pesticide analyses indicated low levels of pesticides were detected in each of the surficial samples analyzed with the highest total pesticide concentration detected in SO-09 (44.9 ug/kg), located in the southern portion of the area and the lowest total pesticide concentrations detected in SO-01 and SO-02, located adjacent to the residence. Petroleum hydrocarbon fractions were detected in each of the surficial samples analyzed, excluding SO-02 (located adjacent to the residence). All total petroleum fraction concentrations were generally low (less than 300 mg/kg) with the exception of SO-05 (950 mg/kg).

In October 2004, four soil borings (SB-7 through SB-10) were advanced to further characterize subsurface soils in this area (previously only sampled the upper half-foot of soils; refer to Figure 5-3a for their locations). One sample from each boring was analyzed by the laboratory for VOCs, SVOCs, metals, PCBs, and pesticides. The sample that exhibited the highest soil jar headspace measurement with the total VOC analyzer from each boring was submitted for VOC analyses. The sample results are presented on Tables 5-3a through 5-3e. The complete analytical results are provided in the Appendix I tables.



The analytical results indicated that relatively low concentrations of VOCs were detected in three of the four samples (SB-7 only detected a low concentration of acetone) and primarily consisted of ethylbenzene, toluene, acetone, n-butylbenzene, n-propylbenzene, p-isopropyltoluene, styrene, and xylenes. All constituents, except for acetone, are generally characterized as purgeable aromatic hydrocarbons. The maximum concentrations of VOCs were detected in SB-8 (2.5 foot depth with a total VOC concentration of 3.89 mg/kg).

Concentrations of SVOCs, predominantly PAHs, were detected in SB-8, SB-9, and SB-10 with the maximum concentration of total SVOCs detected in sample SB-8 (780 mg/kg). The pesticide, 4,4'-DDD, was the only pesticide detected in the samples (SB-8 at a concentration of 1.08 mg/kg) and only one sample (SB-10) detected a low concentration of PCBs. The concentrations of metals detected in the soil borings were similar to those concentrations detected in the surface soil samples presented above.

Groundwater, as presented in Section 4, flows across this area in a southwesterly direction towards Sutton Brook. As such, monitoring well couplet WES-6 and WED-7 are located upgradient of this area of the Site and MW-1S and MW-1R are located further downgradient and adjacent to the Sutton Brook. As indicated on the analytical summary table provided in Section 3, groundwater samples from these wells have been analyzed on several different occasions for multiple parameters. The complete analytical results are presented in Appendix I.

Aside from low concentrations of inorganics, no other constituents (VOCs, SVOCs, PCBs, or pesticides) were detected above the laboratory's minimum reporting limits in groundwater from any of these four wells during the latest sampling round in November 2004, with the exception of chloroethane (2.5 ug/l in WES-6) and bis(2-ethylhexyl)phthalate (7.3 ug/l in MW-1S). In 1999, groundwater from microwells DEP-4 and DEP-5 were collected for laboratory analyses. These two wells are located adjacent to and downgradient of the garage area. Aside from low concentrations of xylene and inorganics, no other constituents were detected in the analyses. These wells could not be located during the 2004/2005 RI activities.

Based on the investigation activities conducted in this area, the following findings are provided:

- The majority of the area contains surficial debris from past dumping and storage activities;
- Impacted surficial soils (predominantly PAHs and petroleum hydrocarbons, with lower concentrations of VOCs, PCBs and pesticides) are present on the south central portion of the area and most likely were caused by former storage or operation activities in this area;
- A subsurface fill area, comprised of wood, metal and concrete, is present on the southern portion of the area (ITTP-9, ITTP-10, SB-9, and SB-10).
- Groundwater does not appear to be impacted from operations in this area.

Additional evaluation of this area was performed in the baseline risk assessment.

5.4 SUTTON BROOK AND ASSOCIATED TRIBUTARIES AND WETLAND AREAS

The remainder of the Site not located within the limits of the landfill lobes, former Drum Disposal Area, and former residence, garage and storage area is comprised primarily of wetland areas associated with Sutton Brook and its tributaries. A photograph of the upper reaches of Sutton Brook on the Site is shown to the right. As discussed in Section 4.2, the main hydrologic feature at the Site is Sutton Brook and associated tributaries and wetlands.



**Sutton Brook – Upstream
(eastern portion of the Site)**



Sutton Brook is a medium gradient stream that includes both moderately moving water through established banks and slower moving water through much wider and less-established channels. Sutton Brook originates in an upland area north of the Site and flows southerly, turning westerly to northerly through the Site with discharge to the Shawsheen River approximately 2,500 feet northwest of South Street.

As Sutton Brook traverses the Site, the character of the brook is affected by the channel width, the channel depth, the composition of the soils underlying the brook, and tributaries that contribute to the brook. At its narrowest and shallowest point, on the neighboring property northeast of the Site, the brook is approximately 3 feet wide by 1 foot deep. The brook then enters the site through a culvert, which passes underneath the access road (former railroad bed). From this point, the brook gradually becomes both wider and deeper, as a clearly defined channel forms adjacent to and between the two landfill lobes. The stream bed from the culvert at the access road, to the westward bend around the northern lobe is primarily gravel and sand.

As the brook enters the area between the landfill lobes, it passes through a culvert underneath the crossing between the two landfill lobes. After this intermediate culvert, the channel remains, though the depth becomes less defined, as the bottom changes to muck and peat. The brook passes between the landfill lobes until opening up into a wetland south of the former drum disposal area (and northwest of the southern lobe). It is in this area, where the channel is widest and deepest, approximately 30 feet wide by 5 feet deep. It is also at this point, that during high water, along with groundwater discharge and contributions from its tributaries, the brook tops its banks creating the aquatic wetland that covers the western portion of the Site. As the brook passes through the area north of the adjoining residential neighborhood, the channel reforms prior to flowing through the culvert that passes under South Street and eventually to the Shawsheen River.

Along its path, additional flow is discharged to the brook via three separate tributaries. One tributary flows northerly, draining a wetland area southeast of the site and discharging into the brook on the southeast side of the site. Another tributary flows northerly, draining an area south of the Site and discharging into the brook on the western portion of the Site. The third tributary flows southerly, draining a wetland area north of the site and discharging into the brook on the northwest portion of the site.

Water table and surface water elevations across the entire site were measured during the RI. Stream gauging was also performed on multiple occasions. These events aid in understanding the site groundwater-surface water flow interactions as well as any contributions from tributaries to Sutton Brook, incorporating seasonal variation.

As indicated from the stream gauging results summarized in Section 4, Sutton Brook and its tributaries experience significant changes in flow between the low water (September 2005) and high water (June 2006) seasons. For example, estimated water flow increased approximately 3,500 gallons per minute at the culvert between the two lobes during this time period.

Measurements taken from stream gauging rods and from well piezometers along the brook indicate that the surface water elevation varies as much 1 foot from low to high water conditions and that groundwater elevation (near the brook) varies as much as 4 feet from low to high water conditions. At times of low water (late summer and early fall), the smaller tributaries (southeast of the site and north of the site) tend to dry up.

Based on the water level measurements, overall, groundwater was found to be discharging to the brook; whereas the wetlands area and smaller tributaries experienced variable elevations suggesting periods of groundwater discharge and recharge throughout the seasons.

The 100 year flood water elevation specific to the Site is mapped to the 82 foot contour line west (downstream) of the intermediate culvert across Sutton Brook and to the 84 foot contour line east



(upstream of the culvert). The 10-year flood water elevation is approximately 0.5 feet lower in elevation than the 100 year flood elevation.

The groundwater data collected across the Site indicates that there are two primary contaminant plumes in groundwater beneath the Site. The primary sources of these plumes are the former Drum Disposal Area and the Southern Lobe. As contaminants within these plumes migrate away from the source area, portions of the plumes discharge into the wetland areas and the brook. The results of the surface water and sediment sampling within the brook and wetland areas generally correlate well with groundwater contamination and groundwater plume discharge areas. The highest concentrations of constituents (primarily VOCs and metals) were detected in surface water and sediment samples from the brook in the reach that traverses closest to the landfill lobes.

Outside of the brook, the area is mainly comprised of wetlands; characterized as the following:

- Very large red maple swamp/floodplain associated with Sutton Brook (> 50 acres)
- Small, shallow, isolated, man-made pond (approximately 2 acres)
- Isolated land subject to flooding
 - Isolated, relatively small forested wetland (man-made)
 - Borrow pit (man-made)
 - Isolated emergent wetland

The red maple swamp is a significant feature across the entire site. It includes floodplain and wetland basins associated with Sutton Brook and the tributary streams. The soils in this area are deep organics underlain by sandy loams. This wetland area and associated tributaries are shown on Figure 5-4a and a photograph of the wetland is shown below.

The sampling program developed as part of the RI of this area consisted of collecting surface water and sediment samples from the brook and tributaries, wetland soil samples, and groundwater samples. The sampling locations, excluding reference sampling locations, are shown on Figure 5-4a. Samples have been collected on several different occasions and analyzed for VOCs, SVOCs, metals, PCBs/pesticides, and other parameters as discussed below. In addition, the USGS and EPA conducted a passive-vapor diffusion sampler survey along Sutton Brook (143 locations) in 2001 to assess potential groundwater discharge zones (see Figure 5-4b).



Wetland north of Southern Lobe

Based on the site reconnaissance conducted as part of the RI, for the most part, the wetland areas and brook have been undeveloped/undisturbed with the exception of the areas in proximity to the landfill lobes where waste material and debris was observed adjacent to or within the wetlands.

The discussion of the RI in this area is presented in the following sections:

- Sutton Brook
- Associated Wetlands



- Associated Tributaries
- Area South of the Southern Lobe

5.4.1 Sutton Brook

Conditions within Sutton Brook were evaluated through collection of samples from 18 surface water locations and 26 sediment locations for laboratory analysis between 1989 and 2006. As summarized on the analytical testing summary tables provided in Section 3, the majority of these samples were analyzed for VOCs, SVOCs, metals, PCBs, and pesticides. In support of the ecological risk assessment, additional parameters, including AVS/SEM, nitrates, sulfates, TOC, etc. were also collected for analyses. These results are presented and discussed in the risk assessment. The complete analytical results are provided in Appendix I.

The analytical results for the surface water sampling indicated that 20 VOCs were detected in the samples with toluene, 1,1,1-TCA, 1,2,4-trimethylbenzene, ethylbenzene, and xylenes being some of the most commonly detected constituents (refer to Table 5-4a). The higher concentrations of VOCs were detected in the samples collected immediately downstream of the landfill lobes (SW-4(99), SW-34, and SW-35). In addition, concentrations of 1,4-dioxane and tetrahydrofuran (detected in groundwater adjacent to the landfill, refer to Section 5.1) were also detected in the surface water samples in between the two landfill lobes. Low concentrations of certain SVOCs have also been detected sporadically over time (refer to Table 5-4b). Certain metals (arsenic, barium, nickel, and zinc) were also detected at the greatest frequency in the surface water samples (refer to Table 5-4c). Concentrations of pesticides (4,4'-DDT and alpha-BHC) were also detected in a 1999 sample (SW-05) collected in between the two lobes. Low concentrations of petroleum hydrocarbons (16.5 to 68.3 ug/l) were detected in the four samples collected in 1999.

The analytical results from the sediment sampling indicated that 21 different VOCs were detected in the samples with ethylbenzene, isopropylbenzene, n-propylbenzene, and xylenes being detected at the greatest frequency. The higher concentrations of VOCs and SVOCs were detected in the samples collected in between the two landfill lobes (SD-01(89), SD-22 (99) and SD-33(04)), refer to Tables 5-4d and 5-4e. Concentrations of PAHs were detected in the downstream sample adjacent to South Street (SD-03(95) - potentially effected by road run-off) and concentrations of phthalates were detected in sample SD33 (04) (adjacent to the lobes). The metals, arsenic, barium, chromium, cobalt, copper, and zinc, were detected at the greatest frequency in the sediment samples. The maximum concentration of metals was detected in sample SD-33(99), located in between the two landfill lobes (refer to Table 5-4f). Concentrations of pesticides were detected in several samples located downstream in the vicinity of South Street, but not at upstream locations.

The results of the EPA/USGS PVD survey indicated concentrations of petroleum hydrocarbons in sediments along an approximately 2,000 foot section of the brook where it flows between the Northern and Southern landfill lobes (refer to Figure 5-4b). An area of petroleum-hydrocarbons was also detected in a section of the brook downgradient of the southern lobe (MW-4S/4B). An area of chlorinated VOCs was detected in sediments in the section of the brook adjacent to the Former Drum Disposal Area.

Surface water quality parameters along the length of Sutton Brook were measured in August 1999 (partial measurements), November 2004, and most comprehensively in September 2005, a late-summer event representative of low-flow conditions. Water quality parameters were also measured from four stations in the brook during the pre-ROD monitoring events. Data from the September 2005 sampling event, which consisted of field measurements at 24 locations along the length of Sutton Brook, are illustrated in Figure 5-4c to show comparisons between the reaches. A review of these results, with specific comparison to concurrent groundwater measurements collected in 2004, help to illustrate the potential effects of the landfill on stream chemistry. A summary of this data is presented in Table 5-4g.



As shown on Figure 5-4c, all measured parameters show significant variability between the 2004 and 2005 sampling events, likely related to seasonal water level effects between relatively high November 2004 flow and the lower, late summer flow of September 2005, which likely had a greater component of groundwater base flow. Dissolved oxygen (DO) in both 2004 and 2005 events was highest near the eastern edge of the stream, just downstream from the access road; in this reach the stream is relatively shallow (1-2 ft.) and passes through a series of riffles. DO in the stream in 2005 declined steadily after this point, as the likely result of the greater depth-to-width ratio as the channel deepens to over 4 ft, and increased oxygen depletion in deep, mucky sediments, particularly in the reach in the constricted area between the landfill lobes [SW-32(04) and SW-34(04)]. The contribution of low DO groundwater in 2005 may also be a factor. However, the contribution of groundwater on DO levels appeared to have little effect in 2004. In 2004, stream DO between SW-32(04) and SW-34(04) ranged from 5.4 to 6.2 mg/l, while the DO measured in shallow, nearshore wells and geoprobes (GP-3, 4, 12, 13, 14, and MW-5) were generally < 1 mg/l DO.

Conductivity increased in 2005 in the stream reach between the landfill lobes, suggesting a potential groundwater contribution. However, as with DO, 2004 results did not show this trend. In 2004, stream conductivity ranged from 0.368 mS/cm to 0.538 mS/cm, while the conductivity of nearshore groundwater was much higher, ranging from 0.648 to 4.27 mS/cm. Likewise, groundwater flux in 2004 appeared to have little effect on stream pH; concurrent stream and groundwater measurements collected in 2004 show that the stream between the landfill lobes had a slightly lower pH than groundwater. Specifically, in 2004 the stream pH between SW-32(04) and SW-34(04) ranged from 6.04 to 6.29, while the pH of nearshore groundwater (GP-3, 4, 12, 13, 14, and MW-5) ranged from 6.09 to 7.3. The 2005 stream data show a sharp decline in pH between the landfill lobes, but then fluctuate between 6.0 and over 7.0 for the remainder of the reach. In general, measured values were typical of New England streams and waterways.

Stream temperature measured in the Upper Sutton ranged generally between 15 and 20° C. In 2005, the temperature of surface water increased from 15.6°C. to 21.5°C downstream of SW-33(04), which may reflect either groundwater effects or greater incidence of high-angle sunlight in that open-water reach of forested wetland. Values obtained in the November 2004 sampling were lower and more consistent, ranging from 9.2°C at SW-32(04) to 5.7° C at SW-34(04). Nearshore groundwater (in locations cited above) at this same time were higher, ranging from 16.7° near SW-32(04) to 8.75°C in MW-5, near SW-34(04).

5.4.2 Associated Tributaries

Three tributaries are associated with Sutton Brook in proximity to the Site. The northernmost tributary flows in an easterly direction between the former Residence, Garage, and Storage Area and the former Drum Disposal area, merging with Sutton Brook, near South Street (refer to Figure 5-4a). Co-located surface water and sediment samples (SW/SD-38) were collected from this tributary in 2004. The samples were analyzed for VOCs, SVOCs, total metals, PCBs, and pesticides (refer to Tables 5-4a - 5-4f). In addition, the surface water sample was analyzed for 1,4-dioxane, hardness, nitrate, and sulfate. The sediment sample was also analyzed for acid volatile sulfide/simultaneously extracted metals (AVS/SEM), grain size, and total organic carbon.

The analytical results for the surface water sample indicated that a low concentration of one VOC (methyl-tert butyl ether) and certain metals were detected in the surface water samples. The analytical results for SD-38 indicated that low concentrations of VOCs and metals were detected in the sample. SVOCs, PCBs, and pesticides were not detected above the laboratory's reporting limit in either sample.

The second tributary to Sutton Brook is located on the western portion of the Site and flows northerly, merging with Sutton Brook southeast of the residential neighborhood. Co-located sediment and surface water samples (SW-08/SD-16) were collected in 1999 (refer to Figure 5-4a). The samples were analyzed



for VOCs, SVOCs, total metals, cyanide, PCBs, and pesticides (refer to Tables 5-4a - 5-4f). A second sediment sample (SD-17) collected at this location was also analyzed for metals.

The analytical results for the surface water sample indicated that concentrations of chlorinated VOCs, purgeable aromatics, and certain metals were detected. Pesticides were not detected in the surface water sample. The analytical results for SD-16 indicated that low concentrations of one VOC (acetone), metals, and certain pesticides were detected in the sample. Similar types and concentrations of metals were reported for both sediment samples. SVOCs and PCBs were not detected above the laboratory's reporting limit any sample.

The third tributary to Sutton Brook is located east of the Southern Landfill Lobe and south of the Northern Lobe, where it merges with Sutton Brook. Co-located sediment and surface water samples (SW-09/SD-15) and a second sediment sample SD-14 were collected from this tributary in 1999. A surface water and sediment sample (SW/SD-43) was collected in 2004 further upstream within this tributary. Samples SW-09, SW/SD-43 and SD-14 were analyzed for VOCs, SVOCs, total metals, cyanide, PCBs, and pesticides (refer to Tables 5-4a - 5-4f). Sample SD-14 was analyzed for metals.

The analytical results for the surface water samples indicated that only certain metals were detected. Pesticides were not detected in any of the samples and VOCs (except a low concentration of toluene and acetone in SW-43), SVOCs, and PCBs were not detected in the surface water sample. The analytical results for SD-14 indicated that low concentrations of VOCs (2-butanone, acetone, and toluene), one SVOC (benzo(a)pyrene), and metals were detected in the sample. Similar types and concentrations of metals were reported for both SD-14 and SD-15 sediment samples. No concentrations of VOCs, SVOCs, or PCBs/pesticides were detected in sediment sample SD-43. The highest arsenic and iron concentrations for all sediment samples collected from Sutton Brook and its tributaries were detected in samples from this tributary (SD-14 and SD-15).

The further assess the nature and extent of the arsenic and iron concentrations in this tributary, six sediment samples (SD-202 to SD-207) were collected from locations along the channel from its confluence with Sutton Brook upstream to the crossing with the dirt access road to the composting facility and Krochmal Farm (see Figure 5-4a). Throughout this length, the stream lies within a clearly defined cut channel that follows a sinuous path through shrubs and vegetation along its course. Sediment in this area generally consisted of brown, wet, fine to medium sands with some silty-sand and small amounts of fibrous materials.

Two samples (SD-200 and SD-201) were also collected upstream of the access road to the compost facility and Farm (see Figure 5-4a). Sample SD-201 was located in a pooled area just upstream from the road culvert, consisting of approximately 3 feet of water over 2 feet of very soft muck, underlain by firmer silty sands. SD-200 was in a forested shrub wetland, approximately 150 feet upstream of SD-201. Six sediment samples (SD-208 through SD-213) were also collected from the upper portion of Sutton Brook, near and downstream of the confluence of the Southern Tributary with Sutton Brook (see Figure 5-4a).

The samples were analyzed for arsenic and iron concentrations and the results are presented on Table 5-4f. A summary of the arsenic results for each of the samples is shown on Figure 5-4d. As indicated on the table and figure, arsenic and iron were detected in each of the samples, although the concentrations of both arsenic and iron were much lower than previously reported in sediment samples SD-14(99) and SD-15(99). Specifically, arsenic in sediment samples collected from the Southern Tributary ranged from 9.4–130 mg/kg in 2006 compared to the average arsenic concentrations in 1999 of 587 mg/kg and that in 2004 of 88 mg/kg. Iron concentrations in sediment samples collected from the Southern Tributary ranged from 8,000–21,000 mg/kg in 2006 compared to the average iron concentrations in 1999 of 69,300 mg/kg and that in 2004 of 9,700 mg/kg. Following sample evaluation, toxicity tests were conducted at select locations to aid in the ecological risk assessment.



5.4.3 Associated Wetlands

Wetland soil/sediment conditions in the area of Sutton Brook were evaluated through collection and analysis of nine wetland soil samples and six wetland sediment samples between 1999 and 2005. The term wetland soil is differentiated from sediments in that wetland soils were collected from moist areas that were slightly higher in elevation, vegetated with free-standing vascular plant communities, and otherwise more characteristic of moist, but not inundated, conditions. Sample locations are shown on Figure 5-4a. As summarized on the analytical testing summary tables (Section 3), the majority of these samples were analyzed for VOCs, SVOCs, metals, PCBs, and pesticides.

The wetland soil analytical results showed generally low concentrations of VOCs in the wetland soils (refer to Table 5-4h). No one sample exhibited higher concentrations of all VOCs; however, the samples in proximity to the landfill lobes and Former Drum Disposal Area generally exhibited higher VOC concentrations (WS-15 and WS-10). SVOCs were only detected in two samples, with maximum concentrations detected at SD-12(99), which is located in the area southeast of the Northern Lobe on the upstream portion of Sutton Brook and closest to the dirt access roads to the composting facility (refer to Table 5-4i). Metals were detected in all samples, with slightly higher concentrations on the side of Sutton Brook, opposite the landfill lobes [SD-12 (99) and SD-13 (99)], refer to Table 5-4j. The metals results for two soil samples [WS-106 (05) and WS-107 (05)] collected as part of the Phase IB RI activities in 2005 to further evaluate this area confirmed similar types and concentrations of metals as previously detected. Low concentrations of pesticides were detected in only one sample, SD-12.

The wetland sediment analytical results showed similarities to the wetland soil results. Twenty-one VOCs were detected in the wetland sediment, with 2-butanone, acetone, and toluene being detected most frequently. Sample location WS-15 (04), which is the closest sample location to the landfill lobes relative to the other wetland sediment sample locations, was the single location with the most VOCs detected (18 different VOCs, ranging from 5.9 ug/kg ethyl ether to 350 ug/kg isopropylbenzene). Only two different SVOCs (bis(2-ethylhexyl)phthalate and naphthalene) were detected separately at two wetland sediment sample locations WS-7 (04) and WS-15 (04) which are both downgradient of the landfill lobes (WS-7 from the Southern Lobe and WS-15 from the Northern Lobe). Metals were detected in all of the wetland sediment samples, again with higher concentrations found generally in those samples located downgradient of the Northern Lobe and/or the Former Drum Disposal Area (WS-10 (04) and WS-15 (04)). Refer to Tables 5-4d, 5-4e, and 5-4f for detected VOC, SVOC, and metals results of the wetland sediment, respectively.

In addition to the sampling data described above, 20 monitoring wells are located within this area, four of which are temporary wells installed in 2004 (GP-7, GP-8, and GP-10) and 2005 (WP-8). Most of the wells were installed primarily to aid in determining the nature and extent of site-wide groundwater contaminants (i.e., not specifically installed to assess groundwater contamination from sources within this area). Three of the wells (WP-8, WP-9, and WP-10) were installed to aid in evaluating groundwater to surface water discharge and to evaluate contaminants in shallow groundwater. A summary of the groundwater results is briefly presented below and discussed (site-wide) in Section 5.5, incorporating all wells on the Site.

Concentrations of VOCs, including 1,4-dioxane, SVOCs, total and dissolved metals and cyanide were detected in groundwater wells located in the vicinity of Sutton Brook. Maximum concentrations of contaminants have been consistently detected in intermediately screened wells. In addition, a very low concentration of one pesticide was detected in one well during its initial 1999 sampling event, but has not been detected during its more recent 2001 sampling event. Concentrations of PCBs have not been detected above the reporting limits in any wells located this area. Low concentrations of a few contaminants have been sporadically detected in the bedrock well samples over time.



Well points (WP-8 and WP-9) were installed within the aquatic wetland located north of Sutton Brook and downgradient of the former Drum Disposal Area. Based on the low level VOC and metals contamination detected in samples from these wells, groundwater impacted from the former Drum Disposal Area appears to be discharging to this wetland. Well point (WP-10) was installed in the aquatic wetland located south of Sutton Brook and downgradient of the Southern Lobe. No VOC concentrations were detected in the sample from this well.

5.4.4 Area South of the Southern Lobe

The area south of the Southern Lobe is located on the southern portion of the Site and is comprised of a shallow pond and dirt trails currently used by recreational vehicles (see Figure 5-4a and 5-4e). The pond which is generally less than 5 feet deep (see photograph below) appears man-made given the presence of a berm along the pond's edge and exposed sand substrates, which suggest past excavation activities. In addition, based on a review of the 1963 and 1978 aerial photographs, the pond is not present at these times, but does appear in a 1995 photo. There is no inlet or outlet to the pond and the depth of the southwest portion of the pond intersects the water table surface (elevation of approximately 83 feet NAD 88).

The pond is sandy-bottomed, and is not believed to contain fish. No fish were observed in the pond during sampling, which involved moving around much of the pond by boat and inspecting the pond bottom, which is visible over the large shallow areas. In addition, tadpoles were observed mowing in large groups in shallow water areas; such abundance is atypical of water bodies containing fish, which typically feed on amphibian eggs and embryos. Water depth is less than 4 feet over much of the area of the pond, extending to approximately 7 feet or so near the eastern end. Because of its location to the south of the Southern Lobe, the pond is likely to be hydraulically up or side-gradient to groundwater under the landfill.



Man-Made Pond – Southwest of Southern Lobe

As part of the RI activities, four co-located surface water and sediment samples (SW/SD-39 through SW/SD-42) were collected in October 2004 from areas spatially distributed throughout the pond (see Figure 5-4e) and analyzed for VOCs, SVOCs, total metals, PCBs, and pesticides. In addition, the surface water samples were analyzed for 1,4-dioxane, dissolved metals (1 sample), hardness, nitrate, and sulfate and the sediment samples were analyzed for total organic carbon and grain size. The analytical results for the sediment samples indicated that SVOCs, PCBs, and pesticides were not detected above the laboratory's reporting limit in any of the samples. Very low concentrations of three VOCs acetone (9 and 24 ug/kg), carbon disulfide (1.4 J and 1.6 J ug/kg), and p-isopropyl toluene (25 ug/kg) were detected in two of the four samples (SD-39 and SD-42). Several metals were also detected in each of the four samples (refer to Table 5-4k).

The analytical results for the surface water samples indicated that VOCs, 1,4-dioxane, SVOCs, PCBs, pesticides, and sulfate were not detected above the laboratory's minimum reporting limit in any of the four surface water samples. Low concentrations of several total and/or dissolved metals were detected in the samples (refer to Table 5-4l). Lower to non-detect dissolved metals were reported in comparison to



the total metals concentrations. Based on the surface water and sediment sample results, the pond has not been impacted from site operations.

Another feature within this area is an isolated forested wetland or “deep marsh” located northeast of the pond and adjacent to the Southern Lobe (see Figure 5-4e). Portions of this area also appear to be man-made as a result of past excavation activities. This area consists of an area of relatively deep (>3 feet) standing water at the western end of the marsh, with a transition to a forested shrub-scrub wetland near the eastern end. Standing water at the western end may be permanent, based on apparent depth and vegetation (cattails), while standing water at the eastern end is likely to be present during wet periods only. This wetland area drains across the trail from the Southern Lobe into the larger wetland area located north of this area.

Two sediment samples (SD-01 and SD-02) were collected in 1999 and analyzed for VOCs, SVOCs, metals, cyanide, PCBs, and pesticides. Certain VOCs, SVOCs, and metals were detected in both these samples.

To further delineate the extent of impacts to this area, four additional co-located surface water and sediment samples (SW/WS-102 through SW/WS-105) collected as part of the Phase 1B RI activities in 2005 were analyzed for VOCs, SVOCs, total metals, PCBs, and pesticides. In addition, the sediment samples were also analyzed for total organic carbon and pH. The surface water samples were also analyzed for 1,4-dioxane, dissolved metals, hardness, nitrate, and sulfate.

As with the original sediment samples from the area, concentrations of certain VOCs, SVOCs, and metals were detected in these samples (refer to Tables 5-4m, 5-4n, 5-4o). Concentrations of VOCs and total/dissolved metals were also detected in the surface water samples (refer to Tables 5-4p and 5-4q).

Six sediment samples were collected from locations within the Deep Marsh during the November 2006 sampling event: SD-216 through SD-221. The locations at which the November 2006 samples were collected are shown on Figure 5-4e and consisted generally of pools and channels of standing water amidst tussocks or elevated sections of wetland shrubs and second-growth white pine, red maple, birch and red oak.

As with the previous sediment samples from the area, concentrations of certain VOCs, SVOCs, and metals were detected in these samples (refer to Tables 5-4m, 5-4n, 5-4o). As indicated on these tables, several organic compounds, along with mercury, were detected in the November 2006 samples and the results were similar in nature to the existing samples.

In addition to the sampling data described above, two shallow well points (WP-6 and WP-7) were installed to aid in evaluation groundwater to surface water discharge and the type and concentrations of contaminants in shallow groundwater within this area. Two monitoring wells (MW-15 and GP-19) are also located southwest of the wetland area. Tables 5-4r (VOCs), 5-4s (SVOCs), 5-4t (metals) present the groundwater results. A summary of the groundwater results is presented below and discussed (site-wide) in Section 5.5.

As presented in Section 4, the southern portion of this area (area of the man-made pond) is hydraulically upgradient from the southern landfill lobe; however, the northeastern portion (forested wetland) may be subject to groundwater discharge. The analytical results indicated that shallow groundwater has been impacted by concentrations of VOCs, SVOCs and metals. A comparison of the shallow groundwater results to those compounds detected in the sediment and surface water indicated that impacted shallow groundwater is discharging to this wetlands area. Groundwater impacted from the Southern Lobe appears to be discharging to the isolated wetland on the northeast portion of this area since groundwater contaminants have been detected in overburden groundwater at wells WP-6 and WP-7. Concentrations of VOCs, the primary site contaminant, have not been detected in MW-15 and GP-19.



5.4.5 Summary

Based on the investigation activities conducted in this area, the following findings are provided:

- The highest concentrations of constituents (primarily VOCs and metals) were detected in surface water and sediment samples from the brook in the reach that traverses closest to the landfill lobes. A drawing depicting this finding is presented as Figure 5-4f. On this drawing, the concentrations of purgeable aromatics and tetrahydrofuran in surface water and total xylenes in sediment (as a surrogate VOC) along the reach of the brook is depicted;
- As presented in Sections 5.1 and 5.2, the data indicates that there are two primary contaminant plumes in groundwater beneath the Site. The sources of these plumes are the Former Drum Disposal Area and the Southern Lobe. As contaminants within these plumes migrate away from the source area, these plumes discharge into the wetland area and the brook. The results of the surface water and sediment sampling (PVD and laboratory analytical) within the brook and wetland areas correlate well with groundwater contamination and groundwater plume discharge areas.
- Contaminants (VOCs, SVOCs, and metals) were detected in surface water, sediment, and shallow groundwater in the wetland area/deep marsh located adjacent to the southern side of the Southern Lobe.

5.5 AREA WIDE GROUNDWATER

As indicated throughout Sections 5.1 through 5.4, the primary impacted media and migration pathway from the source areas is groundwater. Other affected media include sediment and wetland soils; however, these affected areas are localized. Based on a review of the analytical data collected from groundwater (both current and historic sampling events), the primary constituents detected in area-wide groundwater are VOCs and metals, although SVOCs are detected at lower frequencies as well. A characterization of area-wide groundwater, incorporating the groundwater quality data in relation to the hydrogeologic characteristics of the site (as presented in Section 4) is presented in the following sections:

- Investigation Methods
- Summary of Analytical Results
- Groundwater Contaminant Assessment

5.5.1 Investigation Methods

The horizontal distribution of the groundwater sampling locations was based on the direction of groundwater flow (and likely contaminant migration pathways) determined during various stages of the investigation activities completed to date, as well as property and equipment access limitations. In general, the depths of the groundwater sampling locations (permanent monitoring wells, temporary wells and stream piezometers) installed during the RI investigation portion of the program were installed either at the water table surface, an intermediate depth in the overburden, or in bedrock. The intermediate screened wells were positioned at the locations where the highest volatile organic vapor headspace readings were measured during the soil field screening program (using the portable field gas chromatograph, as described in Section 4) or at a specific depth to assess the levels of contaminants at that depth. The field screening results were generally in good correlation with the groundwater samples collected from subsequently installed monitoring wells.

The purpose of the groundwater and surface water sampling events was to obtain a current understanding of contaminant distribution. A summary of the groundwater and surface water sampling locations is presented below.



Sampling Location	Number of Locations
Monitoring Wells	56
Temporary Wells	38
Surface Water Sampling Stations	44

Including historical groundwater data, groundwater samples were collected from the monitoring well network on numerous separate sampling events conducted between 1995 and 2006, including the pre-ROD monitoring program. All wells were sampled at least twice with the exception of the stream piezometers installed during the Phase 1B RI activities and samples collected from some of the temporary wells (GP's). The groundwater samples were collected in order to assess the distribution of contaminants in the groundwater directly adjacent to and downgradient of the landfill lobes and the Former Drum Disposal Area (i.e., source areas) and to fill data gaps identified during review of existing groundwater information.

A summary of the groundwater samples collected from the monitoring locations are provided below.

Parameter	Number of Samples
VOCs	279
1,4-Dioxane	216
total metals	270
SVOCs/PAHs	158
PCBs	58
pesticides	47
cyanide	30
monitored natural attenuation parameters	43
dissolved metals	15
general chemistry parameters	10
petroleum hydrocarbons	7

Groundwater sample locations, dates, and analytical testing parameters for each well were presented in Tables 3-5 (groundwater monitoring wells) and 3-6 (temporary wells).

Surface water samples were collected from the sampling locations to aid in identifying the nature and distribution of impacted surface waters. The surface water sample locations, dates, and analytical testing parameters were presented in Table 3-8. The number of samples tested for each analytical group, including the pre-ROD monitoring program, is as follows:

Parameter	Number of Samples
VOCs	55
1,4-Dioxane	39
SVOCs	37
Total metals	53
Dissolved metals	31
PCBs/Pesticides	28
Cyanide	12
Petroleum hydrocarbons	4



To further evaluate and aid in predicting the movement and velocity of groundwater across the site, as well as to facilitate the evaluation of corrective measures for groundwater, a numerical groundwater model was constructed. The numerical groundwater model simulates a conceptual model of groundwater based on a review of the environmental setting of the site (Section 4 of this report) and various assumptions based on the current understanding of site geologic and hydrogeologic conditions. A complete report summarizing all supporting information and procedures utilized in the construction of the groundwater model is presented in Appendix F.

5.5.2 Summary of Analytical Results

A summary of the analytical results from groundwater samples collected during the RI is presented in this section. For relative consistency purposes, this evaluation does not include the 18 groundwater wells sampled in 2006 (three events) as part of the pre-ROD monitoring program. As indicated above the 2006 data is presented in Section 6 of this document (Contaminant Fate & Transport). The groundwater analytical testing results indicated:

- VOCs, metals and SVOCs were detected at various locations and concentrations in groundwater in the upper and lower overburden aquifers and bedrock;
- only low concentrations of PCBs (aroclor 1254 detected in 1 sample in 2001) pesticides (2 samples in collected 1999 detected just above laboratory detection limits) were reported; and
- petroleum hydrocarbons were only detected in one temporary well (DEP-2 sampled in 1999) located downgradient of the drum disposal area.

Based on a review of the analytical data collected from groundwater (both current and historic sampling events), the primary constituents detected in site groundwater are VOCs, metals and SVOCs. A summary of the most frequently detected VOCs, sorted by number of wells with the detected VOC in at least 10 site wells is provided below.

Analytical Parameter	detections	# wells detected
Xylenes	71	43
1,1-Dichloroethane	55	38
Toluene	55	34
Benzene	47	34
1,4-Dioxane	39	34
Tetrahydrofuran	38	33
Ethylbenzene	52	32
Isopropylbenzene	41	29
cis-1,2-Dichloroethene	35	26
Ethyl ether	27	25
Chloroethane	30	24
1,2,4-Trimethylbenzene	31	21
n-propylbenzene	25	19
Trichloroethene	24	17
1,3,5-Trimethylbenzene	23	17

The most frequently detected VOCs and those detected at the higher concentrations in groundwater were: xylenes, toluene, ethylbenzene, 1,4-dioxane, and tetrahydrofuran. Other more frequently detected VOCs (as indicated above) were generally detected at lower concentrations (1,1-dichloroethane and benzene) and some of the VOCs detected at higher concentrations (4-methyl-2-pentanone and 2-butanone) were not widely distributed in groundwater across the Site. The complete groundwater analytical results are provided in Appendix I.



Further review of data indicates that approximately 53% of the predominantly detected VOCs can be categorized as purgeable aromatic hydrocarbons (BTEX compounds [benzene, toluene, ethylbenzene, and xylene], isopropylbenzene, 1,2,4-trimethylbenzene, n-propylbenzene and 1,3,5-trimethylbenzene). Chlorinated aliphatic hydrocarbons (1,1-DCA, TCE, etc), ketones (4-methyl-2-pentanone and 2-butanone), 1,4-dioxane and tetrahydrofuran make up the remaining predominantly detected VOCs.

With regard to total metals (excluding general chemistry constituents such as calcium, manganese, potassium, etc.), the most frequently detected inorganic constituents in area wide groundwater were arsenic (detected in approximately 72% of the samples analyzed), nickel (60%), aluminum (52%), cobalt (50%), vanadium (44%), zinc (37%), chromium (29%), beryllium (20%), cadmium (19%), copper (17%), lead (12%), silver (8%), thallium (4%), antimony (4%), cyanide (40% - from 1995 and 1999 data only) and mercury (3%).

For relative comparison purposes, metals concentrations were compared to maximum contaminant levels (MCLs). This comparison indicated that concentrations of total arsenic were the most predominant metal detected in excess of the applicable MCL (a total of 63 sampling locations with arsenic detected in excess of the MCL), followed by beryllium (21 locations), cadmium (20 locations), thallium (8 locations) and selenium (2 locations).

Beryllium and cadmium were detected at levels above MCLs at several locations during previous groundwater sampling events with most exceedances observed in the June/July 1999 data set. Upon review of all the beryllium and cadmium data, all locations with samples previously detected in excess of the MCL have been subsequently sampled at least once (and some up to 6 additional rounds, including the pre-ROD sampling) and results have generally exhibited levels below the MCLs (0.004 and 0.005 mg/l for beryllium and cadmium, respectively) with the exception of monitoring well MW-4S (most recently sampled in October 2006). Thallium concentrations in MW-3B and MW-5 also exceeded the MCL (0.002 mg/l) in 2006. Selenium concentrations have been detected below their applicable MCL since 1999.

With regard to SVOCs, the predominant contaminants detected were as follows:

SVOC	Detections	# wells detected	Overall % detected in groundwater
3-Methylphenol/4-Methylphenol	34	8	34%
4-Methylphenol	12	9	29%
Phenol	35	14	24%
2-Methylphenol	31	10	21%
Benzoic Acid	21	6	20%
Diethyl phthalate	26	9	17%
Naphthalene	24	15	6%
2,4-Dimethylphenol	10	5	6%

As shown above, the predominant SVOCs detected in groundwater across the site are generally classified as phenols and phthalates. Phenols (2,4-dimethylphenol, 2-methylphenol, 3-methylphenol/4-methylphenol, 4-methylphenol, and phenol) and phthalates (primarily diethyl phthalate) constitute the bulk of the SVOC contaminants. Naphthalene was detected in less than 10% of the groundwater samples analyzed (includes SVOC and VOC analytical methods). In all, SVOC compounds were detected in approximately 42% of the samples analyzed for SVOCs.

The surface water analytical testing results indicated:

- no PCBs were detected above the laboratory's minimum reporting limits in any of the samples analyzed for these constituents;



- low concentrations of pesticides were detected in three surface water samples and low concentrations of petroleum hydrocarbons were detected in each of the four surface water samples collected in 1999; and
- levels of VOCs, metals and SVOCs were detected in surface water.

A summary of the most frequently detected VOCs, sorted by number of locations with at least 10 detections, is provided below.

Analytical Parameter	detections	# locations detected
Toluene	27	20
Acetone	21	19
Tetrahydrofuran	22	16
Xylenes	23	15
1,4-Dioxane	22	13
Ethylbenzene	17	11
1,1,1-Trichloroethane	12	10

Similar to groundwater, the predominant constituents detected tend to be the purgeable aromatic hydrocarbons (toluene, ethylbenzene and xylenes), 1,4-dioxane, tetrahydrofuran and 1,1,1-TCA.

Metals, both total and dissolved, were also detected in surface water. Specific to total metals concentrations, the most frequently detected inorganic constituents in surface water were zinc (detected in approximately 94% of the samples), nickel (84%), arsenic (66%), cobalt (61%), aluminum (59%), vanadium (46%), lead (38%), copper (34%), and chromium (26%). The remaining metals were generally detected in less than 10% of the samples.

Similar to groundwater, the predominant SVOC contaminants detected primarily consisted of phenols, phthalates and naphthalene. A summary of the most frequently detected SVOCs, sorted by number of locations with detected SVOCs, is provided below.

SVOC	Detections	# locations detected
Naphthalene	9	9
Bis(2-ethylhexyl) phthalate	4	4
Phenol	3	3
4-Methylphenol	2	2
2-Methylphenol	2	2
3-Methylphenol/4-Methylphenol	1	1
2,4-Dimethylphenol	1	1
Di-n-octylphthalate	1	1

Although not in the same frequency order as groundwater, the SVOCs detected in surface water were in the same general classes as those detected in groundwater. Overall, the surface water results support the findings that groundwater discharges to surface water in this area of the brooks/wetlands.

5.5.3 Contaminant Assessment

A review of the groundwater and surface water analytical data collected for the site indicates that the predominant contaminant classes in terms of frequency of detection and concentration level are VOCs, metals and SVOCs. Figures depicting an interpretive extent of the plume for those predominant constituents (purgeable aromatic hydrocarbons, 1,4-dioxane, and tetrahydrofuran) are provided as Figures



5-5a through 5-5c, respectively. In addition, a total VOC plume configuration is also presented as Figure 5-5d.

These figures depict the Southern Lobe and the Former Drum Disposal Area as the primary source areas for these contaminant plumes at the Site. The total VOCs, purgeable aromatic hydrocarbons, and tetrahydrofuran plumes are similar in configuration; whereas the 1,4-dioxane plume is more widespread, detected at lesser concentrations, and suggests source contribution from both landfill lobes. This may be attributable to 1,4-dioxane being more soluble and less degradable than the aromatic hydrocarbons.

These figures also show that the plumes are generally contained within the immediate boundaries of the Site (i.e., plume configurations are controlled by groundwater flow, discharge to the brook and associated wetlands, and degradation/attenuation mechanisms). Further evaluation of the fate and transport of the VOC contaminants is presented in Section 6.

Based on the results of the inorganic analysis, arsenic was the predominant contaminant detected above MCLs. Figure 5-5e depicts the interpretive extent of total arsenic in groundwater. Unlike the VOC plumes, arsenic concentrations in groundwater in excess of MCLs are also detected in upgradient wells suggesting that arsenic concentrations may be naturally occurring at “elevated” levels. A more detailed discussion of the nature and distribution of arsenic in groundwater is presented in Section 6. In this section additional chemistry information supports the finding that arsenic concentrations likely increase in site groundwater due to microbial iron reduction under reducing conditions.

The predominant factors that will ultimately control the migration pathways of the contaminant plumes are the hydrogeologic environment, the location and characteristics of the source areas, and the partitioning/migration characteristics of the specific contaminants comprising the plume. As groundwater flows through the source areas, VOCs partition into the groundwater and migrate with groundwater flow away from the source areas forming a dissolved VOC plume.

In the area of the Southern Lobe, it appears that groundwater (based on potentiometric head data) and the dissolved VOCs (based on concentrations detected in monitoring wells) initially migrates away from the source area in a predominantly northeasterly to northerly direction. In the area of the Former Drum Disposal Area, the dissolved VOCs initially migrate in a southwesterly to westerly direction towards Sutton Brook and the associated wetlands. Once both plumes reach the general vicinity of the brook/wetlands, the plumes merge with regional groundwater flow and travel in a predominantly northerly flow direction.

To aid in estimating the rate of contaminant movement, the numerical groundwater model was used to simulate hydrogeologic conditions and the movement of groundwater in the vicinity of the site. The results of the model-simulated groundwater flow directions were generally consistent with groundwater flow directions configured from the groundwater level measurements. Based on the particle tracking analysis performed as part of the model calibration, the simulated discharge locations for particles placed in the source areas were consistent with mapped contaminant locations. An overlay of the interpreted configuration of the purgeable aromatic plume in groundwater onto the simulated regional groundwater contours is presented as Figure 5-5f.

A discussion on the fate and transportation of these groundwater plumes in the subsurface is presented in Section 6.0.

5.6 REFERENCE LOCATIONS

To establish a reference data set for this RI/FS, both previous site investigation data and newly collected data during the RI have been considered. Samples used in defining reference areas included samples collected from areas that have similar physical, chemical, geological, and biological characteristics as the site, but have not been affected by site activities or releases. These areas may be impacted from other



“sources” not related to the site. For example, areas include the adjacent Krochmal farm, the adjacent composting facility, all-terrain vehicle use of dirt roads in the area, or vehicular traffic impacts.

The reference locations are depicted on Figure 5-6a and have been divided into three categories, as described below and in the following paragraphs.

- Sutton Brook and Associated Tributaries
- Undeveloped Areas Located Hydraulically Upgradient of the Site
- Off-site Residential Areas

5.6.1 Sutton Brook and Associated Tributaries

With regard to Sutton Brook, reference samples were collected immediately upstream of the site and further downstream at the confluence with the Shawsheen River, respectively. In addition, surface water and sediment samples were collected from the southern tributary, which flows northerly past the composting facility and discharges into the brook on the southeastern portion of the Site.

A summary of the specific sampling locations collected from this area is presented below. The sample locations are shown on Figure 5-6a.

Sutton Brook and Associated Tributaries

Area	Sediment			Surface Water	
<i>Reference Samples</i>					
Sutton Brook (upstream)	<u>Oct 1989</u> SD-02(89)	<u>Aug 1999</u> SD-06/07(99) SD-10/11(99)	<u>Dec 2004</u> SD-30(04)	<u>Aug 1999</u> SW-11(99)	<u>Dec 2004,</u> <u>Nov 2005,</u> <u>Feb 2006,</u> <u>Oct 2006</u> SW-30 <u>Nov 2006</u> SW-222(06)
Southeastern Tributary – near composting area	<u>Nov 2006</u> SD-200(06) SD-201(06)				
Sutton Brook – downstream near Shady Lane	<u>Aug 1999</u> SD-30(99)			--	
Shawsheen River – upstream of confluence with Sutton Brook	<u>Aug 1999</u> SD-18(99) SD-19(99)			<u>Aug 1999</u> SW-07(99)	
Shawsheen River – downstream of confluence with Sutton Brook	<u>Aug 1999</u> SD-31(99)			<u>Aug 1999</u> SW-01(99)	
Shawsheen River – downstream near I-93	<u>Aug 1999</u> SD-33(99)			--	
Total Reference Samples	13			8	

A summary of the specific analytical parameters that each sample was analyzed for at the laboratory is presented as Table 3-7 (sediment) and Table 3-8 (surface water). As indicated on these tables, the reference samples (Group 7) were analyzed for the same parameters as the samples collected within the boundaries of the site. Summary tables of the detected inorganic parameters for reference samples are presented as Tables 5-6a (sediment) and 5-6b (surface water). Other detections are discussed below. The complete laboratory analytical data for the reference samples (all media) are presented in Appendix I.

Typical laboratory VOC contaminants (i.e., acetone, 2-butanone and carbon disulfide) were detected in both sediment and surface water samples. Bis(2-ethylhexyl)phthalate was also detected in two surface water samples at trace concentrations. In addition, three different pesticides were detected in the sediment and surface water samples.



A more detailed discussion of how the reference samples have been used in the RI is presented in the baseline risk assessment and Feasibility Study.

5.6.2 Undeveloped Areas Located Hydraulically Upgradient from the Site

As described in Section 4, Sutton Brook is the primary hydrologic feature on the site and its location controls groundwater flow directions in this vicinity, and thus areas considered hydraulically upgradient of the site. There are two areas that are considered both undeveloped and hydraulically upgradient to the site: the first is located to the east of the landfill on property generally referred to as the Perkins Development Trust property and the second is located to the south of the landfill lobes. These areas, therefore provide good site reference locations.

As part of the RI, reference soil and groundwater samples have been collected from both of these areas. A summary of the specific sampling locations collected from this area is presented below. The sample locations are shown on Figure 5-6a.

Undeveloped Upgradient Locations

Area	Upland Soil	Wetland Soil	Groundwater
<i>Reference Locations</i>			
Eastern Area (Perkins property)	<u>Oct 1989</u> SS-13(89) <u>Aug 1999</u> SS-01(99) SS-02(99) WED-02(99) (subsurface) <u>May 2002</u> PMW-4(02) PMW-5(02) PMW-6(02) <u>Nov 2004</u> SS-1(04) SS-2(04)	<u>Aug 1999</u> SD-08(99) SD-09(99) <u>Nov 2005</u> WS-112(05) WS-113(05)	<u>Sep 1999</u> WES-01 WED-02 WEB-03 <u>June 2002</u> PMW-4 PMW-5 PMW-6 <u>Dec 2004/Jan 2005</u> MW-23B WES-01 WED-02 WEB-03 <u>Sep 2005, Dec 2005,</u> <u>Feb 2006, Jun 2006, and</u> <u>Oct 2006</u> PMW-6 MW-23B <u>Nov 2006</u> PMW-4
Southern Area	<u>Nov 2004</u> SS-3(04) <u>Nov 2005</u> SS-108(05)	<u>Nov 2004</u> WS-4(04) <u>Nov 2005</u> WS-109(05)	<u>Mar 2001</u> MW-19S MW-19D MW-19B <u>Nov 2004</u> MW-19S MW-19D MW-19B <u>June 2006</u> MW-19S MW-19D
Southeast Area –near composting area	<u>Nov 2005</u> SS-110(05)	<u>Nov 2005</u> WS-111(05)	<u>Nov 2004</u> GP-26
Total Reference Samples	12	7	30



A summary of the specific analytical parameters that each sample was analyzed for at the laboratory is presented as Table 3-4 (soil) and Tables 3-5 and 3-6 (groundwater). As indicated on these tables, the reference samples (Group 7) were analyzed for the same parameters as the samples collected within the boundaries of the site. Summaries of the detected analytical results for the reference soil and groundwater samples collected are presented as: Tables 5-6c through 5-6f (soil) for VOCs, SVOCs, metals, and PCBs/pesticides; and Tables 5-6g (groundwater) metals only. Other detections found in groundwater from the undeveloped upgradient locations are discussed below.

Typical laboratory VOC contaminants (i.e., acetone and chloroform) were detected in the groundwater samples described above. However, ethylbenzene and xylene were also detected: ethylbenzene in one sample from MW-19D, and xylene (total) from MW-19D and MW-19B. In addition, two separate SVOCs (diethyl phthalate and phenol) were detected in groundwater collected from bedrock monitoring wells MW-19B and WEB-03.

A more detailed discussion of how reference samples have been used in the RI is presented in the baseline risk assessment and Feasibility Study.

5.6.3 Off-Site Residential Areas

Since the early 1990's, numerous investigations and sampling activities have been conducted by the MassDEP and EPA within the residential neighborhood located to the northwest of the Site. Based on a review of historical information and aerial photographs, no site-related landfill operations appear to have occurred in these residential areas prior to development as residences (most of these properties pre-date the landfill). As presented in Section 4, this residential neighborhood is hydraulically upgradient to cross gradient to the groundwater contaminant plumes associated with the Former Drum Disposal Area and landfill lobes. This was confirmed further upon installation, monitoring and sampling of the new monitoring wells installed at Bemis Circle (MW-25/25M) and Serenity Drive (MW-24/24M). Additional discussion on the installation of these wells and the determinations made based on the hydrogeologic features encountered are provided in Sections 2 and 4.

Based on these data, samples collected from within this neighborhood are considered reference data. The specific use of this data and the respective analytical results (soil or groundwater) will be determined in the baseline risk assessments.

5.6.3.1 Soil and Groundwater

A summary of the specific reference soil and groundwater sampling locations collected from this area is presented below. The sample locations are shown on Figure 5-6a.

Off-Site Residential Areas

Area	Upland Soil		Groundwater
Reference Locations			
Residential Area	<u>Oct 1989</u>	<u>2000</u>	<u>Dec 2005</u>
	SS-12(89)	SS-01/02(00)	MW-24
	<u>Aug 1999</u>	SS-03(00)	MW-24M
	SS-03(99)	SS-04(00)	MW-25
	SS-05(99)	SS-05(00)	MW-25M
	SS-08(99)	SS-06(00)	
	SS-09(99)	SS-07(00)	<u>Feb 2006</u>
	SS-10(99)	SS-08(00)	MW-24
	SS-11(99)	SS-09(00)	MW-24M
	SS-12(99)	SS-10(00)	MW-25
	SS-13(99)	SS-11(00)	MW-25M
	SS-14(99)	SS-12(00)	
	SS-15(99)		
	SS-16(99)		
	SS-17(99)		
Total Reference Samples	25		8



A summary of the specific analytical parameters that each sample was analyzed for at the laboratory is presented as Table 3-4 (soil) and Tables 3-5 and 3-6 (groundwater). As indicated on these tables, the reference samples were analyzed for the same parameters as the samples collected within the boundaries of the site. Summaries of the detected analytical results for the reference soil and groundwater samples collected are presented as: Tables 5-6c through 5-6f (soil), for VOCs, SVOCs, metals, and PCBs/pesticides; and Tables 5-6g and 5-6h (groundwater). Other detections found in groundwater from the off-site residential areas are discussed below.

In order to provide additional groundwater hydraulic and chemistry data in the area further west of Sutton Brook, two monitoring well couplet locations were installed. Monitoring well MW-24/M was located on Serenity Drive and monitoring well MW-25/M was located on Bemis Circle. The actual locations for these wells were determined in the field and were directed by the presence of underground and overhead utilities (newly installed sewer line, water line, electric lines, and storm drain lines). As such, each location was adjusted approximately 50 feet to the west from the locations originally proposed in the RI workplan. The presence of utilities and their effect on the drilling activities were communicated to EPA during the weekly summary e-mail and monthly conference call.

During the drilling of MW-25, the Town's water supply line was encountered and ruptured. Although all proper pre-drilling and mark-out activities were followed (Dig Safe and Road Opening Permits) and the utilities were marked out in the field, the line was encountered outside of the markings. As indicated in the table below, initial sampling results show evidence of influence from this ruptured water supply line.

Monitoring Well	13-Dec-05			9-Feb-06		
	Bromo-dichloro methane	Dibromo-chloro methane	Chloroform	Bromo-dichloro methane	Dibromo-chloro methane	Chloroform
MW-25	7.3	0.61	44	2.4	<0.5	13
MW-25M	5.6	<0.5	37	2.5	<0.5	18
All concentrations in ug/l.						

These contaminants are classified as trihalomethanes (THMs), which are a by-product of the chlorination of the public water supply encountering naturally occurring organics (present in the subsurface soils). The presence and then subsequent decrease in THM concentrations during the February 2006 sampling (shown above) further supports that the ruptured water supply line was the source of these compounds in groundwater. Future monitoring, in time, will continue to evaluate this condition. There were no other VOCs detected in this area.

In addition to the soil and groundwater samples, one ambient air sample was collected from this reference area (STA 7 (92)) during the 1992 EPA Air Survey. A more detailed discussion of how the reference samples have been used in the RI is presented in the baseline risk assessment and Feasibility Study.

5.6.3.2 Off-Site Residential Water Supply Wells

As previously discussed, Sutton Brook is the primary hydrologic feature at the site, and its location influences groundwater flow direction as well as contaminant transport via groundwater flow. As shown on Figure 5-6b, several private residential wells are present in the vicinity of the Site, although not all wells are actively used. As also shown on this figure, these wells are situated at locations hydraulically upgradient from the Site (based on simulated regional groundwater flow patterns – refer to the groundwater flow model discussion in Section 4 and Appendix F for the complete groundwater model report).



Samples from select wells have been collected for analyses by EPA or MassDEP in 1991, 1992, 1999 and 2002. A summary table of the data collected from these wells is presented on Table 5-6i. Note: specific laboratory data reports for the events were not provided in the referenced documentation.

As indicated on the table, the results from the sampling varied; however, several wells reported concentrations of metals in excess of MCLs (primarily arsenic, cadmium and selenium). In addition, low level concentrations of VOCs have been detected at three separate residences (1201 South Street, 1079 South Street, and the Homestead Lane residence). A summary of the results from these wells is presented below.

1201 South Street

This private well is located at a residence approximately 1,000 feet northeast of the dirt access road to the site in an hydraulically upgradient direction. The closest on-site monitoring wells are the WES-6 and WED-7 couplet located on the landfill side of the dirt access road. Low levels of xylene (5 J ug/l) in 1999 but non-detect in 2004 (WES-6), chloroethane (2.5 ug/l) in 2004 but non-detect in 1999 (WES-6), and 4-methylphenol (4 J ug/l) in 1999 but non-detect in 2004 (WED-7) were detected in the respective wells.

The well located at 1201 South Street has been sampled four separate times, as indicated below and described on Table 5-6i.

- December 1991 – low levels (0.4 to 1.4 ug/l) of VOCs detected in the well; all concentrations below MCLs or MCP GW-1 standards (for compounds with no MCLs)
- June 1999 – non-detect for VOCs and SVOCs
- August 1999 – 1,3-dichlorobenzene (0.6 ug/l) and phenol (1 J ug/l) detected in the well; both below GW-1 standards
- August 2002 – non detect for VOCs and SVOCs

1079 South Street

This private well is located on the adjacent pig farm approximately 400 feet northeast of the dirt access road to the site in an hydraulically upgradient direction. The closest on-site monitoring wells are the WES-6 and WED-7 couplet located on the landfill side of the dirt access road (see above for results from these wells). The well located at 1079 South Street has been sampled two times, as indicated below and described on Table 5-6i.

- December 1991 – tetrachloroethene (0.5 ug/l) detected in the well; concentration below MCL
- August 1999 – non-detect for VOCs and SVOCs

1069 South Street

This former private well is located adjacent to the former Rocco residence within the “site” boundaries and within the area referred to as Group 4. Groundwater monitoring locations within Group 4 and evaluated in the risk assessment included MW-1S, MW-1R, WES-06, WES-07, DEP-4, and DEP-5.

The former well located at 1069 South Street has been sampled 3 times, as indicated below and described on Table 5-6i.

- June 1999 (2nd) – non-detect for VOCs; BEHP was detected at 8.64 ug/L, compared to a MCP GW-1 standard of 6 ug/l
- June 1999 (8th) – non-detect for VOCs and SVOCs
- August 1999 – non-detect for VOCs and SVOCs



Homestead Lane

Unlike the other three private wells, this inactive, former irrigation well (based on documentation from the EPA 2002 sampling event) is located south of the site approximately 1,200 feet from the edge of the Southern Lobe. Based on water levels collected from site monitoring wells and regional and modeled groundwater flow patterns, this location is hydraulically upgradient of the site. It is not anticipated that pumping of this irrigation well would influence groundwater patterns and redirect groundwater from the site to this location (given the assumed pumping rate from a private irrigation well and distance to the site).

The closest on-site monitoring wells are the MW-19 triplet wells located adjacent to the man-made pond. No concentrations of VOCs were detected in the water table well at this location during any of the sampling events and low levels of some VOCs (below 1 ug/l) were detected in the intermediate and bedrock well during one event only (March 2001) and were not detected in the subsequent events.

The Homestead Lane well has been sampled once and detected a concentration of THF (25 ug/l). THF is a commonly found in PVC cement and coatings and may be associated with some of the plumbing for this well. THF is also a constituent detected in groundwater across the site.

Given the proximity of these water supply wells in relation to the site and the regional groundwater flow patterns, these residential water supply wells are found to be hydraulically upgradient from the site (refer to Figure 5-6b). As presented in this Section 5.5, concentrations of metals have been detected in both upgradient background wells as well as in site wells. These concentrations appear consistent with the metals detected in the private wells as well as in the site wells. Given the hydraulics and chemistry data, concentrations of VOCs detected in these private wells are not considered to be site related.

<div>Table 5-1a</div> <div>Concentrations of VOCs Detected in Groundwater (ug/l)</div> <div>Northern Landfill Lobe</div> <div>Remedial Investigation and Feasibility Study</div> <div>Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts</div>																
Sample Location Identifier	Sample Date	Screened Interval (ft)	1,1-Dichloro ethane	1,2,4-Trimethyl benzene	1,2-Dichloro benzene	1,2-Dichloro ethane	1,3,5-Trimethyl benzene	1,4-Dichloro benzene	1,4-Dioxane	Acetone	Benzene	Chlorobenzene	Chloroethane	Chloroform	cis-1,2-Dichloro ethene	Dichloro difluoromethane
MW-2S	06/28/95	5 - 15													2.8	
	07/02/99		<5	<5	<1	<5	<5	<1			<5	7.97	<5	<5	<5	<5
	11/16/04		<0.75	<2.5	<2.5	<0.5	<2.5	1.4 J	67	<5 UJ	2.2	14	<1	<0.75	<0.5	<5
MW-2B	06/28/95	23 - 37														
	07/07/99		<5	<5	<1	<5	<5	<1			<5	<5	<5	<5	<5	<5
	11/16/04		<0.75	<2.5	<2.5	<0.5	<2.5	<2.5	<5	<5 UJ	<0.5	<0.5	<1	<0.75	<0.5	<5
MW-3S	10/30/95	9-19		1.9	0.79		12				7.2	8.1				
	07/07/99		<5	<5	<1	<5	<5	1.22			7.25	6.2	<5	<5	<5	<5
	09/13/99				<10			2 J								
	09/16/99		<10			2 J				<10 UJ	9 J	11	<10	<10		
	11/16/04		<0.75	<2.5	<2.5	<0.5	<2.5	3.6	160	<5	7.5	12	<1	<0.75	<0.5	<5
	09/21/05		<1.5	<5	0.79 J	<1	<5	4.6 J	230 J	<10 UJ	7.6	15	<2	<1.5	<1	<10
	12/19/05		<1.5	<5	0.7 J	<1	<5	3.8 J	45	<10	4.8	7.9	<2	<1.5	<1	<10
MW-3B	12/19/05	38 - 51.5	<0.75	<2.5	<2.5	<0.5	<2.5	<2.5	2.6 J	<5	<0.5	<0.5	<1	<0.75	<0.5	<5
	07/07/99		<5	<5	<1	<5	<5	<1			<5	<5	<5	<5	<5	<5
	09/16/99		<10		<10	<10		<10		<10 UJ	<10	<10	<10 UJ	<10		
	11/16/04		<0.75	<2.5	<2.5	<0.5	<2.5	<2.5	<5	<5	<0.5	<0.5	<1	<0.75	<0.5	<5
	09/21/05		<0.75	<2.5	<2.5	<0.5	<2.5	<2.5	3.4 J	<5 UJ	<0.5	<0.5	<1	<0.75	<0.5	<5 UJ
MW-6	06/28/95	5-15												1.7		
	07/07/99		<5	<5	<1	<5	<5	<1			<5	<5	<5	<5	<5	<5
	11/16/04		0.48 J	<2.5	<2.5	<0.5	<2.5	0.48 J	160	<5 UJ	0.31 J	0.72	<1	<0.75	<0.5	<5
MW-12	06/28/99	4 - 14	<5	168	<1	<5	47.7	6.99			7.2	<5	<5	<5	<5	<5
	11/16/04		1.4	<2.5	0.63 J	<0.5	<2.5	3.4 J	160	2.5 J	5.5	1.8	1.2	<0.75	0.47 J	0.58 J
PMW-1	04/18/02	4 - 14	<1	<1	<1	<1	<1	<1		<50	<1	<1	<1	<1	<1	<1
	06/04/02		1	<1	<1	<1	<1	<1		<50	<1	<1	<1	<1	<1	<1
	11/22/04		0.68 J	<2.5	<2.5	<0.5	<2.5	<2.5	<5	<5	<0.5	<0.5	<1	<0.75	<0.5	<5
PMW-2	04/18/02	4 - 14	<1	<1	<1	<1	<1	<1		<50	<1	<1	<1	<1	<1	<1
	12/08/04				<5			<5								
	01/05/05		<0.75	0.68 J	<2.5	<0.5	<2.5	1.2 J	<5	<5	0.33 J	<0.5	<1	<0.75	<0.5	<5
PMW-3	04/18/02	4 - 14	<1	<1	<1	<1	<1	<1	<50	<50	<1	<1	<1	<1	<1	<1
	11/23/04		0.42 J	<2.5	<2.5	<0.5	<2.5	<2.5	<5 UJ	<5	1.6	<0.5	0.68 J	<0.75	<0.5	<5
GP-1	11/11/04	2 - 12	0.58 J	0.43 J	<2.5	<0.5	<2.5	0.56 J	4.5 J	<5	2	1.5	0.77 J	<0.75	<0.5	1.4 J
GP-2	10/14/04	2 - 12	<7.5	<25	<25	<5	<25	<25	99	<50	4.8 J	<5	<10	<7.5	<5	<50
GP-3	10/14/04	2.2 - 12.2	<7.5	<25	<25	<5	<25	<25	170	<50	6.4	3.5 J	8.8 J	<7.5	<5	<50
GP-4	10/14/04	3.4 - 13.4	<7.5	<25	<25	<5	<25	6.8 J	25 J	<50	3.5 J	10	<10	<7.5	<5	<50
GP-5	10/14/04	8 - 18	<7.5	<25	<25	<5	<25	11 J	61	<50	22	28	<10	<7.5	<5	<50
GP-6	10/14/04	8 - 18	<7.5	<25	<25	<5	<25	5.6 J	540	<50	8.6	18	<10	<7.5	<5	<50
NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit.																

<div>Table 5-1a</div> <div>Concentrations of VOCs Detected in Groundwater (ug/l)</div> <div>Northern Landfill Lobe</div> <div>Remedial Investigation and Feasibility Study</div> <div>Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts</div>																
Sample Location Identifier	Sample Date	Screened Interval (ft)	Ethyl Ether	Ethylbenzene	Isopropylbenzene	Methyl tert butyl ether	n-Butylbenzene	n-Propylbenzene	o-Xylene	p/m-Xylene	p-Isopropyl toluene	tert-Butyl benzene	Tetrahydrofuran	Toluene	Trichloro fluoromethane	Xylenes (total)
MW-2S	06/28/95	5 - 15		3.3	3.5			1.3						29		7.9
	07/02/99			<5	<5		<5	<5			<5	<5		<5	<5	5.69
	11/16/04		4.7	<0.5	1.7	<1	<0.5	0.65	<0.5	<0.5	<0.5	<2.5	55	<0.75	<2.5	
MW-2B	06/28/95	23 - 37														
	07/07/99			<5	<5		<5	<5			<5	<5		<5	<5	<5
	11/16/04		<2.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<10	<0.75	<2.5	
MW-3S	10/30/95	9-19			10			1.6						0.53		7.2
	07/07/99			<5	9.66		<5	<5			<5	<5		<5	<5	<5
	09/13/99															
	09/16/99			<10										<10		3 J
	11/16/04		9.8	<0.5	10	<1	<0.5	1.6	0.72	2.4	<0.5	<2.5	120	0.83	<2.5	
	09/21/05		8.7	<1	11	<2	<1	3.3	1.5	2.5	<1	<5	180	0.89 J	<5	
	12/19/05		5.9	<1	10	<2	<1	1.1	<1	<1	<1	<5	61	<1.5	<5	
MW-3B	12/19/05	38 - 51.5	<2.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<10	<0.75	<2.5	
	07/07/99			<5	<5		<5	<5			<5	<5		<5	<5	<5
	09/16/99			<10										<10		<10
	11/16/04		<2.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<10	<0.75	<2.5	
	09/21/05		<2.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	0.38 J	<0.5	<2.5	<10	<0.75 U	<2.5	
MW-6	06/28/95	5-15		4.7	0.75									79		16
	07/07/99			<5	<5		<5	<5			<5	<5		<5	<5	<5
	11/16/04		6.2	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	3.6 J	<0.75	<2.5	
MW-12	06/28/99	4 - 14		14.1	6.59		9.18	19.4			6.31	22.8		31.5	<5	150
	11/16/04		16	<0.5	1.8	0.56 J	<0.5	0.42 J	<0.5	0.66	<0.5	<2.5	41	<0.75	<2.5	
PMW-1	04/18/02	4 - 14	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<1	17	
	06/04/02		<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<1	28	
	11/22/04		<2.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<10	<0.75	0.68 J	
PMW-2	04/18/02	4 - 14	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	
	12/08/04															
	01/05/05		1.6 J	<0.5	0.55	<1	<0.5	<0.5	<0.5	0.48 J	<0.5	<2.5	6.1 J	<0.75	<2.5	
PMW-3	04/18/02	4 - 14	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	
	11/23/04		1.5 J	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<10	<0.75	<2.5	
GP-1	11/11/04	2 - 12	12	<0.5	0.64	0.38 J	<0.5	<0.5	<0.5	0.42 J	<0.5	<2.5	28	<0.75	<2.5	
GP-2	10/14/04	2 - 12	30	<5	<5	<10	<5	<5	<5	<5	<5	<25	24 J	<7.5	31	
GP-3	10/14/04	2.2 - 12.2	13 J	<5	11	<10	<5	<5	<5	90	<5	<25	200	<7.5	<25	
GP-4	10/14/04	3.4 - 13.4	<25	<5	4 J	<10	<5	<5	<5	<5	<5	<25	30 J	<7.5	<25	
GP-5	10/14/04	8 - 18	6.6 J	<5	7.4	<10	<5	4 J	<5	<5	<5	<25	160	<7.5	<25	
GP-6	10/14/04	8 - 18	13 J	<5	12	<10	<5	<5	<5	<5	<5	<25	250	<7.5	<25	
NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit.																

Table 5-1b

Concentrations of SVOCs Detected in Groundwater (ug/l)
Northern Landfill Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	2,4-Dinitro toluene	2-Methyl naphthalene	4-Nitrophenol	Acenaphthene	Diethyl phthalate	Di-n-butyl phthalate	Isophorone	Naphthalene	Phenol	N-Nitro sopyrrolidine	o-Toluidine	N-Nitro sodi-n-butylamine
MW-2S	06/28/95	5-15												
	07/02/99		<0.5	<0.75	<0.5	0.714	<1.25	<0.75	0.549	<0.75	<0.25	<0.5	<2.5	<0.5
	11/16/04		<6	<8	<10	<5	<5	<5	<5	<2.5 U	<7			
MW-2B	06/28/95	23-37												
	07/07/99		<0.5	<0.75	<0.5	<0.5	<1.25	<0.75	<0.5	<0.75	0.287	<0.5	<2.5	<0.5
	11/16/04		<6	<8	<10	<5	<5	<5	<5	<2.5	<7			
MW-3S	10/30/95	9 - 19								19				
	06/29/95									18				
	07/07/99		0.586	<0.75	<0.5	<0.5	<1.25	<0.75	<0.5	1.05	<0.25	<0.5	<2.5	<0.5
	09/13/99		<10	<10	<25 UJ	<10	<10	<10	<10	5 J	<10			
	11/16/04		<6	<8	<10	<5	<5	<5	<5	31	<7			
	09/21/05									<5 UJ				
	12/19/05									<5				
MW-3B	06/29/95	38 - 51.5												
	07/07/99		<0.5	<0.75	<0.5	<0.5	<1.25	<0.75	<0.5	<0.75	0.792	<0.5	<2.5	<0.5
	09/16/99		<10	<10	<25	<10	<10	<10	<10	<10	<10			
	11/16/04		<6	<8	<10	<5	<5	<5	<5	<2.5	<7			
	09/21/05									<2.5 UJ				
	12/19/05									<2.5				
MW-6	06/28/95	5 - 15												
	07/07/99		<0.5	<0.75	1.18	<0.5	<1.25	<0.75	<0.5	<0.75	<0.25	<0.5	<2.5	1.08
	11/16/04		<6	<8	<10	<5	<5	<5	<5	<2.5 U	<7			
MW-12	06/28/99	4 - 14	<0.5	0.83	<0.5	<0.5	<1.25	1.43	<0.5	46.7	<0.25	9.68	3.16	<0.5
	11/16/04		<6	<8	<10	<5	<5	<5	<5	22	<7			
PMW-1	04/18/02	4-14		<10		<10				<1				
	06/04/02									<1				
	11/22/04		<6	<8	<10	<5	<5	<5	<5	<2.5	<7			
PMW-2	04/18/02	4-14		<10		<10				<1				
	12/08/04		<6	<8	<10	<5	2.4 J	<5	<5	<5	<7			
	01/05/05									0.65 J				
PMW-3	04/18/02	4-14		<10		<10				<1				
	11/23/04		<6	<8	<10	<5	<5	<5	<5	<2.5	<7			
GP-1	11/11/04	2-12								<2.5				
GP-2	10/14/04	2-12								<25				
GP-3	10/14/04	2.2-12.2								20 J				
GP-4	10/14/04	3.4-13.4								<25				
GP-5	10/14/04	8 - 18								17 J				
GP-6	10/14/04	8 - 18								<25				
NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit.														

Table 5-1c

Concentrations of Metals Detected in Groundwater (mg/l)
Northern Landfill Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Superfund Disposal Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	Aluminum		Arsenic		Barium		Beryllium		Cadmium		Calcium		Chromium		Cobalt	
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
MW-2S	06/28/95	5 - 15			0.79		0.23				<0.01				<0.01			
	07/02/99				0.53				0.03		0.03				<0.06			
	11/16/04		<0.07	U	0.697		0.19		<0.0005	U	0.0008	J	97		0.002	J	0.005	J
MW-2B	06/28/95	23 - 37			0.004		0.01				<0.01				<0.01			
	07/07/99				<0.05				0.01		0.03				<0.06			
	11/16/04		<0.079	U	<0.005		0.004	J	<0.0004	U	<0.002		17		0.005	J	<0.01	
MW-3S	06/29/95	9 - 19			0.407		0.28				<0.01				<0.01			
	07/07/99				<0.05				0.01		0.02				<0.06			
	09/13/99		0.0618	J	0.4	J	0.235	J	<0.0001	UJ	<0.0004	UJ	155	J	0.0058	J	0.0042	J
	11/16/04		<0.1		0.207		0.21		<0.002		<0.002	UJ	150		<0.01		<0.01	
	09/21/05		<0.042	U	0.165		0.22		<0.002		<0.002		140		0.008	J	0.005	J
	12/19/05		<0.046	U	0.071		0.16		0.0005	R	<0.002		160		0.004	J	0.003	J
MW-3B	06/29/95	38 - 51.5			0.042		0.04				<0.01				<0.01			
	07/07/99				0.17				0.01		0.05				<0.06			
	09/16/99		0.629		<0.0068		0.031		<0.0001		<0.0004		13.2	J	0.0082		<0.0022	
	11/16/04		<0.1		<0.005		0.058		<0.002		<0.002		24		<0.01		<0.01	
	09/21/05		<0.1		<0.005		0.03		<0.002		<0.002		19		<0.01		<0.01	
	12/19/05		<0.02	U	<0.005		0.03		<0.002		<0.002		17		<0.01		<0.01	
MW-6	06/28/95	5 - 15			0.103		0.26				<0.01				<0.01			
	07/07/99				0.25				0.01		0.03				<0.06			
	11/16/04		0.38	0.02	J	0.213	0.126	0.15	0.11	<0.0005	U	<0.002	<0.002	<0.002	120	100	<0.01	<0.01
MW-12	06/28/99	4 - 14			<0.05				<0.003		<0.005				<0.06			
	11/16/04		<0.093	U	0.116		0.31		<0.0006	U	0.001	J	120		0.004	J	0.003	J
PMW-1	04/18/02	4 - 14			0.158				0.014		<0.005				<0.01			
	06/04/02				0.225				0.012		<0.005				<0.01			
	11/22/04		0.026	J	0.303		0.028		<0.002		<0.002		150		<0.01		0.003	J
PMW-2	04/18/02	4 - 14			<0.05				<0.004		<0.005				<0.01			
	12/08/04		2.5	<0.021	U	0.054	0.008	0.15	0.15	0.0005	J	<0.002	<0.002	<0.002	85	96	0.007	J
PMW-3	04/18/02	4 - 14			<0.05				<0.004		<0.005				<0.01			
	11/23/04		0.049	J	0.006		0.08		<0.002		<0.002		240		<0.01		0.001	J
GP-1	11/11/04	2 - 12			0.118						<0.002							
GP-2	10/14/04	2 - 12			0.065						<0.002							
GP-3	10/14/04	2.2 - 12.2			0.062						<0.002							
GP-4	10/14/04	3.4 - 13.4			0.014						<0.002							
GP-5	10/14/04	8 - 18			0.015						0.0005	J						
GP-6	10/14/04	8 - 18			0.16						0.0005	J						

NOTE:
mg/l = milligrams per liter.
ft = feet below ground surface.
< = less than minimum reporting limit as indicated by the laboratory.
Bold indicates a concentration detected above the reporting limit.
A blank space indicates the sample was not analyzed for this constituent.
U = laboratory result qualified as non-detect due to blank contamination.
J = estimated concentration.
UJ = estimated reporting limit.

Table 5-1c

Concentrations of Metals Detected in Groundwater (mg/l)
Northern Landfill Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Superfund Disposal Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	Copper		Cyanide	Iron		Lead		Magnesium		Manganese		Nickel		Potassium		Silver			
			Total	Dissolved	Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved		
MW-2S	06/28/95	5 - 15	<0.01		<0.01	40		<0.05				3.9						<0.01			
	07/02/99		<0.008				0.02						0.02				<0.007				
	11/16/04		<0.01		17		<0.01		35		1.4		0.0136	J		83		<0.007			
MW-2B	06/28/95	23 - 37	<0.01		<0.01	34		<0.05				0.43						<0.01			
	07/07/99		<0.008				0.07						0.04				<0.007				
	11/16/04		0.004	J		14		<0.01		2.4		0.18		0.0019	J		2.6		<0.007		
MW-3S	06/29/95	9 - 19	<0.01		<0.01	24		<0.05				1.2						<0.01			
	07/07/99		<0.008				<0.02						0.03				0.009				
	09/13/99		<0.002	UJ	0.0042	J	22.9	J	<0.001	UJ	65	J	1.66	J	0.0134	J	118	J	<0.0004	UJ	
	11/16/04		<0.01			29		<0.01		64		0.92		<0.025		120		<0.007			
	09/21/05		<0.01			27		<0.01		63		0.79		0.0158	J	140		<0.007			
	12/19/05		<0.01			26		<0.01		54		0.64		0.0078	J	87		<0.007			
MW-3B	06/29/95	38 - 51.5	0.04		<0.01	59		<0.05				0.7						<0.01			
	07/07/99		0.02				<0.02						0.01				<0.007				
	09/16/99		<0.006		<0.0009	31.6		0.0014	J	3.38		0.592	J	0.0147		3.13		<0.0011			
	11/16/04		<0.01			19		<0.01		6.7		0.34		<0.025		4.8		<0.007			
	09/21/05		<0.01			6.3		<0.01		5.2		0.21		<0.025		3.7		<0.007			
	12/19/05		<0.01			6.1		<0.01		4.6		0.26		<0.025		3.5		<0.0009	U		
MW-6	06/28/95	5 - 15	0.05		<0.01	34		<0.05				3.9						<0.01			
	07/07/99		<0.008				0.08						0.05				<0.007				
	11/16/04		<0.01	<0.01		26	15	<0.01	<0.01	31	28	1.6	1.4	0.0057	J	0.0047	J	55	48	<0.007	<0.007
MW-12	06/28/99	4 - 14	<0.008					<0.02						0.05				<0.007			
	11/16/04		0.009	J		25		0.0087	J	35		0.67		0.0123	J	74		<0.007			
PMW-1	04/18/02	4 - 14	0.105					<0.03						<0.01				<0.007			
	06/04/02		<0.01				<0.005						<0.01				<0.007				
	11/22/04		<0.01		19		<0.01		8		0.28		<0.025		11		<0.007				
PMW-2	04/18/02	4 - 14	0.096					<0.005						<0.01				<0.007			
	12/08/04		0.003	J	<0.01	18	7.4	0.0048	J	<0.01	6.6	7	0.25	0.27	0.0033	J	<0.025	7.5	J	7.7	J
PMW-3	04/18/02	4 - 14	0.179					<0.03						<0.01				<0.007			
	11/23/04		<0.01		5.6		<0.01		11		0.31		0.0016	J	12		<0.007				
GP-1	11/11/04	2 - 12				12		<0.01		12		1.2									
GP-2	10/14/04	2 - 12				24		0.0052	J	32		0.34									
GP-3	10/14/04	2.2 - 12.2				47		<0.01		50		0.5									
GP-4	10/14/04	3.4 - 13.4				26		0.0094	J	21		0.8									
GP-5	10/14/04	8 - 18				62		<0.01		28		0.63									
GP-6	10/14/04	8 - 18				33		<0.01		54		0.3									

NOTE:
mg/l = milligrams per liter.
ft = feet below ground surface.
< = less than minimum reporting limit as indicated by the laboratory.
Bold indicates a concentration detected above the reporting limit.
A blank space indicates the sample was not analyzed for this constituent.
U = laboratory result qualified as non-detect due to blank contamination.
J = estimated concentration.
UJ = estimated reporting limit.

Table 5-1c

Concentrations of Metals Detected in Groundwater (mg/l)
Northern Landfill Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Superfund Disposal Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	Sodium		Vanadium		Zinc	
			Total	Dissolved	Total	Dissolved	Total	Dissolved
MW-2S	06/28/95	5 - 15					0.09	
	07/02/99						<0.01	
	11/16/04		200		0.002 J		0.005 J	
MW-2B	06/28/95	23 - 37					0.02	
	07/07/99						0.08	
	11/16/04		10		<0.01		<0.05	
MW-3S	06/29/95	9 - 19					0.17	
	07/07/99						0.06	
	09/13/99		341 J		0.0044 J		<0.0163 UJ	
	11/16/04		250		<0.01		<0.05	
	09/21/05		280		0.008 J		<0.05	
	12/19/05		140		<0.004 U		<0.05	
MW-3B	06/29/95	38 - 51.5					0.27	
	07/07/99						0.35	
	09/16/99		11.6		<0.0008		0.098	
	11/16/04		16		<0.01		<0.05	
	09/21/05		13		<0.01		<0.05	
	12/19/05		13		<0.001 U		<0.05	
MW-6	06/28/95	5 - 15					0.25	
	07/07/99						0.08	
	11/16/04		90	86	0.001 J	<0.01	0.033 J	<0.05
MW-12	06/28/99	4 - 14					0.03	
	11/16/04		190		0.004 J		0.068	
PMW-1	04/18/02	4 - 14					<0.01	
	06/04/02						<0.01	
	11/22/04		17		<0.01		0.01 J	
PMW-2	04/18/02	4 - 14					<0.01	
	12/08/04		9.2	10	0.009 J	<0.01	0.021 J	0.006 J
PMW-3	04/18/02	4 - 14					<0.01	
	11/23/04		26		0.003 J		<0.05	
GP-1	11/11/04	2 - 12						
GP-2	10/14/04	2 - 12						
GP-3	10/14/04	2.2 - 12.2						
GP-4	10/14/04	3.4 - 13.4						
GP-5	10/14/04	8 - 18						
GP-6	10/14/04	8 - 18						
NOTE: mg/l = milligrams per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. U = laboratory result qualified as non-detect due to blank contamination. J = estimated concentration. UJ = estimated reporting limit.								

Table 5-1d

**Concentrations of Other Parameters Detected in Groundwater
Northern Landfill Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Sample Location Identifier	Sample Date	Screened Interval (ft)	Dissolved Organic Carbon (mg/l)	Iron, Ferrous (mg/l)	Methane (ug/l)	COD (mg/l)	Specific Conductivity (mmhos/cm)	Chloride (mg/l)	Sulfate (mg/l)	Alkalinity (CaCO ₃) (mg/l)	Alkalinity, total (mg/l)	Nitrate - N (mg/l)	Ammonia - N (mg/l)	Hardness (mg/l)
MW-2S	06/28/95	5 - 15				370	3700	450	60		1650	0.04	134	
MW-2B	06/28/95	23 - 37				22	185	10	4		72	<0.02	0.04	
MW-3S	06/29/95	9 - 19				480	4750	600	2	2000		0.09		
MW-3B	06/29/95	38 - 51.5				88	170	8	8	50		0.05		
MW-6	06/28/95	5 - 15				150	1780	380	8		430	0.07	42	
PMW-1	11/22/04	4 - 14	7.3	17	114									
GP-1	11/11/04	2 - 12												200
GP-2	10/14/04	2 - 12												320
GP-3	10/14/04	2.2 - 12.2												430
GP-4	10/14/04	3.4 - 13.4												220
GP-5	10/14/04	8 - 18												480
GP-6	10/14/04	8 - 18												490
NOTE: ug/l = micrograms per liter. mg/l = milligrams per liter. mmhos/cm = micromhos per centimeter ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent.														

Table 5-1e

Concentrations of VOCs Detected in Soil (ug/kg)
Northern Landfill Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	2-Butanone	Acetone	Benzene	Chlorobenzene	Ethylbenzene	p/m-Xylene	Toluene	Xylenes (total)
SS-02 (89)	10/26/89	0 - 0.67	<24	<24	<12	<12	<12		<12	<12
SS-03 (89)	10/26/89	0 - 0.67	<18	<51	<9	<9	<9		<9	<9
SS-04 (89)	10/26/89	0 - 0.67	<21	<21	<10	<10	<10		<10	140
SS-05 (89)	10/26/89	0 - 0.83	<19	<19	<9	<9	<9		<9	<9
SS-08 (89)	10/26/89	0 - 0.67	<24	<24	<12	<12	<12		<12	<12
SS-09 (89)	10/26/89	0 - 0.17	<67	<67	7 J	12 J	450		11 J	2300 J
SS-10 (89)	10/26/89	0 - 0.33	<19	<42	4 J	25	350 J		4 J	310
SD-03 (99)	08/09/99	0 - 0.5	R	84 J EB	7	<6	<6	<6	4 J	
SD-04 (99)	08/09/99	0 - 0.5	R	110 J EB	<10	<10	<10	<10	<10	
PMW-1 (02)	04/11/02	6 - 8	<340	<700	<10	<10	<10	<10	<10	
PMW-2 (02)	04/11/02	7 - 9	<310	<600	<10	<10	<10	<10	<10	
PMW-3 (02)	04/11/02	6 - 8	<350	<700	<10	<10	<10	<10	<10	
GP-1 (04)	11/08/04	0 - 1	72 UJ	420 J	2.1 J	<2.5	10 J	31 J	33 J	
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. EB = compound was detected in the associated equipment blank. UJ = estimated reporting limit. R = result rejected upon validation.										

Table 5-1f

Concentrations of SVOCs Detected in Soil (ug/kg)

Northern Landfill Lobe

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	2-Methyl naphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(ghi) perylene	Benzo(k)fluora nthane	Bis(2-Ethylhexyl) phthalate	Butyl benzyl phthalate	Chrysene
SS-02 (89)	10/26/89	0 - 0.67	5 J	19 J	36 J	420 J	360 J	270 J	550	110 J	780	27 J	23 J	380 J
SS-03 (89)	10/26/89	0 - 0.67	<380	70 J	<380	160 J	370 J	370 J	420	240 J	310 J	160 J	<380	380
SS-04 (89)	10/26/89	0 - 0.67	<410	<410	<410	57 J	77 J	82 J	96 J	<410	80 J	<410	<410	80 J
SS-05 (89)	10/26/89	0 - 0.83	<390	<390	<390	<390	78 J	89 J	110 J	51 J	72 J	370 J	<390	75 J
SS-08 (89)	10/26/89	0 - 0.67	<460	<460	<460	<460	140 J	150 J	200 J	130 J	110 J	1200	69 J	150 J
SS-09 (89)	10/26/89	0 - 0.17	710 J	2300 J	<4200	5000	10000	9500	12000	4700	6800	760 J	480 J	11000
SS-10 (89)	10/26/89	0 - 0.33	290 J	530 J	<800	130 J	410 J	430 J	500 J	130 J	360 J	9400	<800	440 J
SD-03 (99)	08/09/99	0 - 0.05	<400	<400	<400	<400	370 J	390 J	530	240 J	<400	<400	<400	370 J
SD-04 (99)	08/09/99	0 - 0.5	<590	<590	<590	<590	820	900	1300 J	660	470 J	460 J	<590	840
PMW-1 (02)	04/11/02	4 - 6	<400	<400	<400	<400	<400	<400	<400	<400	<400			<400
		6 - 8	<400	<400	<400	<400	<400	<400	<400	<400	<400			<400
PMW-2 (02)	04/11/02	7 - 9	<400	<400	<400	<400	<400	<400	<400	<400	<400			<400
PMW-3 (02)	04/11/02	6 - 8	<400	<400	<400	<400	<400	<400	<400	<400	<400			<400
GP-1 (04)	11/08/04	0 - 1	<1400	<880	<880	<880	<880	<880	<880	<880	<880	<1800	<880	<880

Sample Location Identifier	Sample Date	Depth (ft)	Dibenzo(a,h) anthracene	Dibenzofuran	Diethyl phthalate	Di-n-butyl phthalate	Di-n-octyl phthalate	Fluoranthene	Fluorene	Indeno(1,2,3- cd) Pyrene	Naphthalene	Phenanthrene	Pyrene
SS-02 (89)	10/26/89	0 - 0.67	<480	10 J	24 J	7 J	<480	780	23 J	130 J	15 J	380 J	24 J
SS-03 (89)	10/26/89	0 - 0.67	<380	50 J	<380	<380	<380	760	83 J	250 J	350 J	600	810
SS-04 (89)	10/26/89	0 - 0.67	<410	<410	<410	<410	<410	140 J	<410	60 J	47 J	57 J	130 J
SS-05 (89)	10/26/89	0 - 0.83	<390	<390	<390	<390	54 J	140 J	<390	55 J	<390	52 J	130 J
SS-08 (89)	10/26/89	0 - 0.67	<460	<460	<460	<460	180 J	300 J	<460	<460	<460	230 J	320 J
SS-09 (89)	10/26/89	0 - 0.17	780 J	1300 J	<4200	<4200	<4200	24000	2300 J	5200	1400 J	17000	29000
SS-10 (89)	10/26/89	0 - 0.33	<800	210 J	<800	<800	2500	940	250 J	220 J	1300	670 J	1100
SD-03 (99)	08/09/99	0 - 0.05	<400	<400	<400	<400	<400	760	<400	280 J	150 J	410	620
SD-04 (99)	08/09/99	0 - 0.5	<590	<590	<590	<590	<590	1500	<590	800	860	740	1500 J
PMW-1 (02)	04/11/02	4 - 6	<400					<400	<400	<400	<10	<400	<400
		6 - 8	<400					<400	<400	<400	<10	<400	<400
PMW-2 (02)	04/11/02	7 - 9	<400					<400	<400	<400	<10	<400	<400
PMW-3 (02)	04/11/02	6 - 8	<400					<400	<400	<400	<10	<400	<400
GP-1 (04)	11/08/04	0 - 1	<880	<880	<880	<880	<880	<880	<880	<880	R	<880	<880
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. R = result rejected upon validation.													

Table 5-1g

Concentrations of Metals Detected in Soil (mg/kg)

Northern Landfill Lobe

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Aluminum, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total	Lead, Total	Magnesium, Total
SS-02 (89)	10/26/89	0 - 0.67	10300	5.5	12.4	<0.52	<1.44	3450 J	26.6	10.8	23.9 J	21300	34.9	4060
SS-03 (89)	10/26/89	0 - 0.67	4100	14.3	15.2	<0.25	<1.23	3100 J	48.4	13.1 J	11.2 J	7080	26.3	1890
SS-04 (89)	10/26/89	0 - 0.67	3780	42.4 J	22.6	<0.26	<1.25	4410 J	785	3.3 J	27.9 J	7620	37.8	1180
SS-05 (89)	10/26/89	0 - 0.83	5430	11.9	15.5	<0.33	<1.14	1110 J	11.9	3.8	9 J	5470	8.9	1590
SS-08 (89)	10/26/89	0 - 0.67	8190	<1.11	23.9	<0.4	<1.39	1710 J	17.1	3.5 J	27.9 J	6170	49.9	1530
SS-09 (89)	10/26/89	0 - 0.17	10700	16.8 J	167	<1.7	<1.33	19700 J	25.4	11.6	58.9 J	25000	325	4610
SS-10 (89)	10/26/89	0 - 0.33	9660	13.5	47.5	<0.5	<1.36	1760 J	31.7	7.8	82.9 J	10400	187	2940
SD-03 (99)	08/09/99	0 - 0.5	11900	6.2 J	45.1	<0.69 UJ	R	3300	39.6	9.3	39.1	20900 J	76.6 J	4510
SD-04 (99)	08/09/99	0 - 0.5	16500	20.3 J	83.5	<0.99	0.46	7120	84.5	7	57.8	19800 J	98.9 J	4320
PMW-1 (02)	04/11/02	4 - 6		11.6		<0.5	<0.5		10.7		21.5		26.8	
		6 - 8		70.1		<0.5	<0.5		4.62		7.37		<2.5	
PMW-2 (02)	04/11/02	7 - 9		<5		<0.5	<0.5		8		15.2		<2.5	
PMW-3 (02)	04/11/02	6 - 8		5.81		<0.5	<0.5		5.57		7.82		<2.5	
GP-1 (04)	11/08/04	0 - 1	11000	32 J	130	5.3	0.29 J	10000	24	8.8	9.4	7100	60	1100
NOTE: mg/kg = milligrams per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit. R = result rejected upon validation.														

Table 5-1g

Concentrations of Metals Detected in Soil (mg/kg)

Northern Landfill Lobe

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Selenium, Total	Sodium, Total	Thallium, Total	Vanadium, Total	Zinc, Total
SS-02 (89)	10/26/89	0 - 0.67	458 J	<0.14	11.4 J	714 J	2.6 J	249	<0.58	28.4	76.6 J
SS-03 (89)	10/26/89	0 - 0.67	197.1 J	<0.12	<6.46	490 J	<0.49 UJ	139	<0.49	9.5	34.9 J
SS-04 (89)	10/26/89	0 - 0.67	50 J	<0.13	<6.65	<234.78	<0.51 UJ	31.8 J	<0.51	11.3	129 J
SS-05 (89)	10/26/89	0 - 0.83	59.3 J	<0.11	10 J	803 J	<0.46 UJ	52.2	<0.46	18.9	14.5 J
SS-08 (89)	10/26/89	0 - 0.67	50.6 J	<0.14	<7.21	334 J	<0.55 UJ	79.7	<0.55	12.3	87.6 J
SS-09 (89)	10/26/89	0 - 0.17	305 J	0.23	59.6	2660	<0.53 UJ	516	<0.53	275	188 J
SS-10 (89)	10/26/89	0 - 0.33	96.8 J	<0.14	20.3	1160 J	1.5 J	177	<0.54	25.2	234 J
SD-03 (99)	08/09/99	0 - 0.5	407	0.26 J	17.7	2020	<0.62 UJ	636	<0.93 UJ	28.9	101
SD-04 (99)	08/09/99	0 - 0.5	432	0.31 J	22.6	2560	<1.9 UJ	818	<1.3 UJ	31.4	193
PMW-1 (02)	04/11/02	4 - 6		0.144	6.45		<5		8.22		32.2
		6 - 8		<0.05	2.27		<5		6.23		4.03
PMW-2 (02)	04/11/02	7 - 9		<0.05	4.88		<5		9.32		8.39
PMW-3 (02)	04/11/02	6 - 8		<0.05	4.33		<5		6.57		9.6
GP-1 (04)	11/08/04	0 - 1	1600	0.14 J	5.2	320	1.6	74 J	<1	5.7	18
<p>NOTE:</p> <p>mg/kg = milligrams per kilogram.</p> <p>ft = feet below ground surface.</p> <p>< = less than minimum reporting limit as indicated by the laboratory.</p> <p>Bold indicates a concentration detected above the reporting limit.</p> <p>A blank space indicates the sample was not analyzed for this constituent.</p> <p>J = estimated concentration.</p> <p>UJ = estimated reporting limit.</p> <p>R = result rejected upon validation.</p>											

Table 5-1h

Concentrations of PCBs and Pesticides Detected in Soil (ug/kg)
Northern Landfill Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, MA

Sample Location Identifier	Sample Date	Depth (ft)	Aroclor 1232	Aroclor 1254	4,4'-DDD	4,4'-DDE	4,4'-DDT	alpha-Chlordane	gamma-Chlordane
SS-02 (89)	10/26/89	0 - 0.67	<570	<1100	29 J	30 J	<110	40 J	59 J
SS-03 (89)	10/26/89	0 - 0.67	<450	<900	<90	<90	<90	<450	<450
SS-04 (89)	10/26/89	0 - 0.67	<200	<400	<40	39 J	<40	<200	<200
SS-05 (89)	10/26/89	0 - 0.83	<470	<930	<93	<93	<93	<470	<470
SS-08 (89)	10/26/89	0 - 0.67	2500	<1100	<110	<110	<110	<560	<560
SS-09 (89)	10/26/89	0 - 0.17	<200	500 J	<41	<41	<41	<200	<200
SS-10 (89)	10/26/89	0 - 0.33	<190	610 J	<38	<38	<38	<190	<190
SD-03 (99)	08/09/99	0 - 0.5	<40	<40	<4	8.5	28 J	6.5 J	4 J
SD-04 (99)	08/09/99	0 - 0.5	<59	160	2.9 J	5.3 J	R	R	2.4 J
PMW-1 (02)	04/11/02	4 - 6	<80	<80	<4	<4	<4		
		6 - 8	<80	<80	<4	<4	<4		
PMW-2 (02)	04/11/02	7 - 9	<80	<80	<4	<4	<4		
PMW-3 (02)	04/11/02	6 - 8	<80	<80	<4	<4	<4		
GP-1 (04)	11/08/04	0 - 1	<87.7	<87.7	<35.1	<35.1	<35.1		
<p>NOTE:</p> <p>ug/kg = micrograms per kilogram.</p> <p>ft = feet below ground surface.</p> <p>< = less than minimum reporting limit as indicated by the laboratory.</p> <p>Bold indicates a concentration detected above the reporting limit.</p> <p>A blank space indicates the sample was not analyzed for this constituent.</p> <p>J = estimated concentration.</p> <p>R = result rejected upon validation.</p>									

Table 5-1i

Concentrations of VOCs Detected in Groundwater (ug/l)
Southern Landfill Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	1,1,1-Trichloro ethane	1,1-Dichloro ethane	1,1-Dichloro ethene	1,2,4-Trimethyl benzene	1,2-Dichloro benzene	1,2-Dichloro ethane	1,2-Dichloroethene (Total)	1,2-Dichloro propane	1,3,5-Trimethyl benzene	1,4-Dichloro benzene	1,4-Dioxane	2-Butanone	2-Hexanone	4-Methyl-2-pentanone	Acetone	Benzene
MW-4S	06/28/95	15 - 25		290		39												
	07/08/99		<5	168	<0.96	14.5	<5	<5		<5	<5	<5						23.3
	09/16/99		<100	220	<100		<500	<100	150	<100		<500		13000	<140	4700	6200	38 J
	03/14/01		R	220 J	R	35 J	R	R		R	13 J	R	R	27000 J	450 J	10000 J	21000 J	R
	11/15/04		<50	190	<50	<250	<250	<50		<180	<250	<250	<500	11000	<500	6800	6600	<50
	09/20/05		<100	160	<100	<500	<500	<100		<350	<500	<500	350 J	20000	<1000	7800	13000	<100
	12/15/05		<200	140 J	<200	<1000	<1000	<200		<700	<1000	<1000	240 J	18000	<2000	6500	14000	<200
MW-4B	06/28/95	34 - 44		140		74												
	07/08/99		<250	<250	<48	<250	<2.1	<250		<250	<250	<2.1						<250
	09/14/99						5 J					1 J						
	09/16/99		<1000	<1000	<1000			<1000	<1000	<1000				4600 J	<1000 UJ	11000 J	2400 J	<1000
	03/14/01		R	96 J	0.24 J	25 J	4.5 J	6.9 J		3.4 J	7.3 J	R	R	13000 J	140 J	13000 J	11000 J	19 J
	11/15/04		<50	<75	<50	<250	<50	<50		<180	<250	<50	480	1000	<500	3600	820	<50
	09/20/05		<50	<75	<50	32 J	<49	<50		<180	<250	<49	600 J	<500	<500	1500	<500	<50
MW-5	12/15/05	15 - 25	<50	<75	<50	33 J	R	<50		<180	R	R	570	2900	<500	3000	3100	R
	06/28/95			39		17												
	07/08/99		<50	<50	<9.6	<50	<1	<50		<50	<50	<1						<50
	11/15/04		<2.5	<3.8	<2.5	<12	<12	<2.5		<8.8	<12	<12	200	97	<25	1100	120	6
	09/20/05		<50	<75	<50	<250	<4.9	<50		<180	<250	<4.9	260 J	<500	<500	720	<500	<50
WED-05	12/14/05	unknown	<50	<75	<50	R	R	<50		<180	R	R	230	260 J	<500	1300	420 J	R
	09/13/99		<10	<10	<10		<10	<10	<10	<10		<10		<10 UJ	<10 UJ	<10 UJ	<10 UJ	<10
WES-04	11/15/04	unknown	<0.5	<0.75	<0.5	<2.5	<2.5	<0.5		<1.8	<2.5	<2.5	<5	<5	<5	<5	<5	<0.5
	09/13/99		<10	<10	<10		<10	<10	<10	<10		<10		<10 UJ	<10 UJ	<10 UJ	<10 UJ	<10
GP-9	11/15/04	10 - 20	<0.5	<0.75	<0.5	<2.5	<2.5	<0.5		<1.8	<2.5	<2.5	<5	<5 UJ	<5 UJ	<5	<5 UJ	<0.5
	11/11/04		<0.5	2.6	<0.5	2.9	1.7 J	<0.5		0.37 J	1.3 J	9.6	<50	17	9.4	10	40	2.3
GP-11	11/02/04	7 - 17	<100	280	<100	280 J	<500	<100		<350	120 J	<500	<1000	2000	<1000	1900	1800	<100
GP-12	10/21/04	3 - 13	<50	60 J	<50	2600	<250	<50		<180	640	<250	<500	<500	<500	63 J	<500	<50
GP-13	10/21/04	5 - 15	130	530	<120	<620	<620	<120		<440	<620	<620	320 J	6500	<1200	9500	720 J	<120
GP-14	10/21/04	3 - 13	<2.5	3.1 J	<2.5	20	<12	<2.5		<8.8	7.5 J	3.3 J	<25	<25	<25	<25	12 J	7.5
GP-15	10/21/04	6.7 - 16.7	<12	9.7 J	<12	<62	<62	<12		<44	<62	<62	28 J	370	<120	620	360	<12
GP-16	10/21/04	10 - 20	<25	56	<25	<120	<120	<25		<88	<120	<120	79 J	<250	<250	91 J	<250	<25

NOTE:
ug/l = micrograms per liter.
ft = feet below ground surface.
< = less than minimum reporting limit as indicated by the laboratory.
Bold indicates a concentration detected above the reporting limit.
A blank space indicates the sample was not analyzed for this constituent.
J = estimated concentration.
UJ = estimated reporting limit.
R = result rejected upon validation.

<div>Table 5-1i</div> <div>Concentrations of VOCs Detected in Groundwater (ug/l)</div> <div>Southern Landfill Lobe</div> <div>Remedial Investigation and Feasibility Study</div> <div>Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts</div>																		
Sample Location Identifier	Sample Date	Screened Interval (ft)	Carbon disulfide	Chloro benzene	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloro ethene	Dichloro difluoro methane	Ethyl Ether	Ethylbenzene	Isopropyl benzene	Methylene chloride	n-Butyl benzene	n-Propyl benzene	o-Chlorotoluene	o-Xylene	p/m-Xylene
MW-4S	06/28/95	15 - 25						180			160	8.5	1900		11			
	07/08/99			<5	<5	<5	<5	83.8	<5		72.2	<5	2140	<5	<5	<5		
	09/16/99		<100 UJ	<100	<100	<100	<100 UJ				160		<3800					
	03/14/01		R	R	R	R	R	160 J	R	270 J	130 J	R	R	R	R	R		
	11/15/04		<500	<50	<100	<75	<250	280	<500	<250	170	<50	<1200 U	<50	<50	<250	120	390
	09/20/05		<1000	<100	<200	<150 U	<500	240	<1000	64 J	130	<100	<1000 U	<100	<100	<500	98 J	300
	12/15/05		<2000	<200	<400	<300	<1000	260	<2000	<1000	130 J	<200	790 J	<200	<200	<1000	<200	260
MW-4B	06/28/95	34 - 44				1.4		23			190	16	33		16			
	07/08/99			<250	<250	<250	<250	<250	<250		<250	<250	<500	<250	<250	<250		
	09/14/99																	
	09/16/99		<1000 UJ	<1000	<1000	<1000	<1000 UJ				120 J		<1000 UJ					
	03/14/01		0.37 J	R	24 J	R	2 J	R	R	300 J	120 J	6.2 J	R	R	3.4 J	R		
	11/15/04		<500	<50	<100	<75	<250	<50	<500	<250	120	<50	<500	<50	<50	<250	110	280
	09/20/05		<500	<50	42 J	<75 U	<250	<50	<500	130 J	100	<50	<500	<50	<50	<250	94	250
MW-5	12/15/05	15 - 25	<500	R	<100	<75	<250	<50	<500	140 J	110 J	R	42 J	R	R	R	100 J	260 J
	06/28/95					4.9		95			140	5.5	850	0.53	3.3			
	07/08/99			<50	<50	<50	<50	91.8	<50		<50	<50	789	<50	<50	<50		
	11/15/04		<25	<2.5	13	<3.8	<12	6.2	<25	29	65	6.4	<25	<2.5	<2.5	<12	77	200
	09/20/05		<500	<50	<100	<75	<250	<50	<500	<250	41 J	<50	<500	<50	<50	<250	48 J	130
WED-05	12/14/05	unknown	<500	R	<100	<75	<250	<50	<500	<250	50 J	R	<500	R	R	R	53 J	160 J
	09/13/99		<10 UJ	<10	<10 UJ	<10	<10 UJ				<10		<10 UJ					
WES-04	11/15/04	unknown	<5	<0.5	<1	<0.75	<2.5	<0.5	<5	<2.5	<0.5	<0.5	<5	<0.5	<0.5	<2.5	<0.5	<0.5
	09/13/99		<10 UJ	<10	<10 UJ	<10	<10 UJ				<10		<10 UJ					
GP-9	11/15/04	10 - 20	<5	<0.5	<1	<0.75	<2.5	4	<5	<2.5	1.3	<0.5	<5	<0.5	<0.5	<2.5	<0.5	2.4
	11/11/04		<5	0.37 J	0.51 J	<0.75	<2.5	10	8.9	<2.5	34	0.61	0.42 J	<0.5	0.56	<2.5	22	75
GP-11	11/02/04	7 - 17	<1000	<100	<200	<150	<500	450	<1000	<500	1900	<100	810 J	<100	<100	<500	440	1200
GP-12	10/21/04	3 - 13	<500	<50	<100	<75	<250	<50	<500	<250	2000	48 J	<500	<50	260	<250	2200	4700
GP-13	10/21/04	5 - 15	<1200	<120	4300	<190	<620	200	<1200	<620	980	<120	520 J	<120	<120	<620	810	3100
GP-14	10/21/04	3 - 13	<25	5.5	9.8	<3.8	<12	<2.5	3.9 J	<12	110	5.3	<25	<2.5	3.5	2.8 J	28	450
GP-15	10/21/04	6.7 - 16.7	<120	<12	<25	<19	<62	20	95 J	<62	83	<12	63 J	<12	<12	<62	48	220
GP-16	10/21/04	10 - 20	<250	<25	<50	<38	<120	160	47 J	<120	150	<25	<250	<25	<25	<120	110	440
NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit. R = result rejected upon validation.																		

Table 5-1i

Concentrations of VOCs Detected in Groundwater (ug/l)
Southern Landfill Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	p-Isopropyl toluene	sec-Butyl benzene	Styrene	Tetrachloro ethene	Tetrahydro furan	Toluene	trans-1,2-Dichloro ethene	Trichloro ethene	Trichlorofluoro methane	Vinyl chloride	Xylenes (total)
MW-4S	06/28/95	15 - 25						2000			150		240
	07/08/99		8.26	<5	<5	10.7		2520	<5	46	106	16.5	238
	09/16/99				<100	17 J		4400		72 J		<100 UJ	490
	03/14/01		15 J	R	R	R	3600 J	3600 J	R	76 J	410 J	R	410 J
	11/15/04		<50	<50	<50	<50	1400	5400	<75	75	<250	<100	
	09/20/05		<100	<100	<100	<100	1000 J	4400	<150	70 J	<500	<200	
	12/15/05		<200	<200	<200	<200	890 J	4300	<300	<200	<1000	<400	
MW-4B	06/28/95	34 - 44		5.4				1300			27		350
	07/08/99		<250	<250	<250	<250		6050	<250	<250	<250	<100	368
	09/14/99												
	09/16/99				<1000	<1000		13000		<1000		<1000	470 J
	03/14/01		5.5 J	R	R	R	5400 J	6300 J	0.57 J	12 J	R	R	390 J
	11/15/04		<50	<50	<50	<50	3700	4700	<75	<50	<250	<100	
	09/20/05		<50	<50	<50	<50	3500	2500	<75	<50	<250	<100	
MW-5	12/15/05	15 - 25	R	R	R	<50	3700	3300 J	<75	<50	<250	<100	
	06/28/95							900			18		215
	07/08/99		<50	<50	<50	<50		456	<50	<50	<50	<20	147
	11/15/04		<2.5	<2.5	<2.5	<2.5	5200	300	<3.8	3	<12	<5	
	09/20/05		<50	<50	<50	<50	6100	120	<75	<50	<250	<100	
WED-05	12/14/05	unknown	R	R	R	<50	6700	210 J	<75	<50	<250	<100	
	09/13/99				<10	<10		<10		<10		<10	<10
WES-04	11/15/04	unknown	<0.5	<0.5	<0.5	<0.5	<10	<0.75	<0.75	<0.5	<2.5	<1	
	09/13/99				<10	<10		<10		<10		<10	<10
GP-9	11/15/04	10 - 20	<0.5	<0.5	<0.5	<0.5	<10	9.5	<0.75	<0.5	<2.5	1	
	09/13/99				<10	<10		<10		<10		<10	<10
GP-9	11/11/04	10 - 20	<0.5	<0.5	<0.5	0.72	2.5 J	340	<0.75	1.1	0.99 J	4.9	
GP-11	11/02/04	7 - 17	<100	<100	240	<100	<2000	12000	<150	<100	<500	<200	
GP-12	10/21/04	3 - 13	<50	<50	<50	<50	<1000	7700	<75	<50	<250	<100	
GP-13	10/21/04	5 - 15	<120	<120	<120	<120	8600	21000	<190	<120	<620	<250	
GP-14	10/21/04	3 - 13	<2.5	<2.5	<2.5	<2.5	21 J	42	<3.8	<2.5	<12	<5	
GP-15	10/21/04	6.7 - 16.7	<12	<12	<12	<12	360	1100	<19	<12	73	<25	
GP-16	10/21/04	10 - 20	<25	<25	<25	<25	180 J	2800	<38	52	<120	35 J	
<p>NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit. R = result rejected upon validation.</p>													

Table 5-1j

Concentrations of SVOCs Detected in Groundwater (ug/l)
Southern Landfill Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	2,4-Dimethylphenol	2-Methylphenol	3-Methylphenol/ 4-Methylphenol	4-Methylphenol	Acetophenone	Benzoic Acid	Diethyl phthalate	Naphthalene	Phenol	Pyridine
MW-4S	06/28/95	15 - 25									1400 J	
	07/08/99		<101	<27	<40.5		<20.3	<270	163	<5	<6.75	<33.8
	09/16/99		58 J	99 J		11000			140 J	<500	2600	
	03/14/01		<2500 UJ	<2500 UJ		9500 J	<2500 UJ		<2500 UJ	R	2100 J	
	11/15/04		<5000	<3000	9100		<10000	<25000	<2500	<250	<3500	<25000
	09/20/05		<4100	<2500	9000		<8200	12000 J	<2100	<500 UJ	<2900	<21000
MW-4B	06/28/95	34 - 44							38			
	07/08/99		<7.88	98.9	8250		30.8	<21	<2.63	<1.58	247	<2.63
	09/14/99		<10	180 J		9900 J			60	240 J	210 J	
	03/14/01		<1200 UJ	<1200 UJ		6600 J	<1200 UJ		<1200 UJ	2.5 J	260 J	
	11/15/04		<100	63	3100		<200	1800	<53 U	<50	87	<500
	09/20/05		<98	64	1500		<200	120 J	61	<49 UJ	<68	<490
	12/15/05		<100	<62	3000		<210	1900	55	R	130	<520
MW-5	06/28/95	15 - 25									1200 J	
	07/08/99		<3.75	<1	<1.5		<0.75	<10	119	<0.75	36.1	<1.25
	11/15/04		<50	46	390		<100	<250	<48 U	<12	<35	<250
	09/20/05		<9.9	23	43		<20	<49	23	<4.9 UJ	<6.9	29 J
	12/14/05		<10	25	300		4.9 J	300	39	R	18	<52
WED-05	09/13/99	unknown	<10	<10		<10			<10	<10	<10	
	11/15/04	unknown	<10	<6	<6		<20	<50	<5	<2.5	<7	<50
WES-04	09/13/99	unknown	<10	<10		<10			<10	<10	<10	
	11/15/04	unknown	<10	<6	6.6		<20	<50	<5	<2.5	<7	<50
GP-9	11/11/04	10 - 20								1.8 J		
GP-11	11/02/04	7 - 17								<500		
GP-12	10/21/04	3 - 13								<250		
GP-13	10/21/04	5 - 15								<620		
GP-14	10/21/04	3 - 13								16		
GP-15	10/21/04	6.7 - 16.7								<62		
GP-16	10/21/04	10 - 20								<120		

NOTE:

ug/l = micrograms per liter.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

J = estimated concentration.

UJ = estimated reporting limit.

R = result rejected upon validation.

Table 5-1k

Concentrations of Metals Detected in Groundwater (mg/l)
Southern Landfill Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadmium		Calcium	
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
MW-4S	06/28/95	15 - 25					0.139		1.6				<0.01			
	07/08/99				<0.05		0.3				0.01		0.34			
	09/16/99		0.0846 J		<0.0022 UJ		0.226		1.38		<0.0001		R		410 J	
	03/14/01		<0.0075		0.0016		0.292		1.23		<0.0005		<0.0001		501	
	11/15/04		<0.1 UJ		<0.006 UJ		0.205 J		0.84 J		<0.003 UJ		0.006 J		330 J	
	09/20/05		0.46	<0.033 U	<0.006	<0.006	0.226	0.143	0.82	0.72	<0.002	<0.002	0.003	<0.002 UJ	420	390
	12/15/05		0.19	0.038 J	<0.006	<0.006	0.201	0.119	0.8	0.65	R	R	0.011	0.009	400	380
MW-4B	06/28/95	34 - 44					1.15		0.39				<0.01			
	07/08/99				<0.05		1.5				0.009		0.06			
	09/14/99		0.0506 J		<0.0022 UJ		1.35		1.35		<0.0001		<0.0004		270 J	
	03/14/01		<0.0075		0.0013		1.49		1.59		<0.0005		<0.0001		353	
	11/15/04		<0.1		<0.006		1.18		1		<0.002		<0.002 UJ		210	
	09/20/05		0.046 J		<0.006		1.18		1		<0.002		<0.002		210	
	12/15/05		<0.056 U		<0.006		1.6		0.97		R		0.0006 J		250	
MW-5	06/28/95	15 - 25					0.875		1.4				<0.01			
	07/08/99				<0.05		0.92				0.008		0.36			
	11/15/04		2.4	<0.1	<0.006	<0.006	0.787	0.255	0.39	0.19	<0.002	<0.002	<0.002	<0.002	81	71
	09/20/05		1.4	<0.051 U	<0.006	<0.006	0.796	0.664	0.51	0.41	<0.002	<0.002	<0.002	<0.002 UJ	100	89
	12/14/05		1.4	0.051 J	<0.006	<0.006	0.781	0.25	0.43	0.18	<0.002	<0.002	<0.002	<0.002	92	79
WED-05	09/13/99	unknown	0.0804 J		<0.0022 UJ		<0.008		<0.0084		<0.0001		<0.0004		17.4 J	
	11/15/04	unknown	0.16		<0.006		0.007		0.01		<0.002		<0.002		21	
WES-04	09/13/99	unknown	0.0486 J		<0.0022 UJ		0.0658		0.0166		<0.0001		<0.0004		20.4 J	
	11/15/04	unknown	<0.1		<0.006		0.052		0.045		<0.002		<0.002		36	
GP-9	11/11/04	10 - 20					<0.005						<0.002			
GP-11	11/02/04	7 - 17					0.0038 J						<0.002			
GP-12	10/21/04	3 - 13					0.588						<0.002			
GP-13	10/21/04	5 - 15					0.132						0.0015 J			
GP-14	10/21/04	3 - 13					0.077						<0.002			
GP-15	10/21/04	6.7 - 16.7					0.34						0.002			
GP-16	10/21/04	10 - 20					0.34						0.007			
NOTE: mg/l = milligrams per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit. U = result qualified as non-detect due to blank contamination. R = result rejected upon validation.																

Table 5-1k

Concentrations of Metals Detected in Groundwater (mg/l)
Southern Landfill Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	Chromium		Cobalt		Copper		Cyanide	Iron		Lead		Magnesium		Manganese	
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
MW-4S	06/28/95	15 - 25	<0.01				0.2		<0.01	758		0.07				42	
	07/08/99		<0.06				<0.008					0.22					
	09/16/99		<0.001		0.0684 J		<0.002		0.0028	761		0.0144 J		127		20.2 J	
	03/14/01		<0.0025		0.0631		<0.0025			720		0.0055		140		19	
	11/15/04		<0.01 UJ		0.015 J		<0.01 UJ			780 J		<0.01 UJ		100 J		12 J	
	09/20/05		<0.01	<0.01	0.01	0.01	0.005 J	0.006 J		700	650	<0.01	<0.01	100	100	10	9.9
	12/15/05		<0.01	<0.01	0.01	0.01	0.005 J	0.003 J		660	600	<0.01	<0.01	100	98	11	10
MW-4B	06/28/95	34 - 44	<0.01				<0.01		<0.01	0.85		<0.05				0.74	
	07/08/99		<0.06				<0.008					0.1					
	09/14/99		0.0012 J		0.0605		<0.0028 UJ		0.0031	90.4		<0.001 UJ		153		0.794 J	
	03/14/01		<0.0025		0.0763		<0.0025			160		<0.0015		139		1.62	
	11/15/04		<0.01		0.03		<0.01			62		<0.01		110		0.32	
	09/20/05		0.002 J		0.02		<0.01			40		<0.01		110		0.12	
	12/15/05		<0.01		0.04		<0.01			79		<0.01		110		0.43	
MW-5	06/28/95	15 - 25	<0.01				0.14		<0.01	430		<0.05				11	
	07/08/99		<0.06				<0.008					0.24					
	11/15/04		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		20	0.27	<0.01	<0.01	69	62	0.08	0.01
	09/20/05		0.008 J	0.005 J	0.008 J	<0.004 U	0.004 J	<0.01		27	17	<0.01	<0.01	82	75	0.08	0.02
	12/14/05		0.008 J	0.005 J	0.006 J	0.004 J	0.004 J	<0.01		22	0.38	<0.01	<0.01	76	68	0.06	0.02
WED-05	09/13/99	unknown	<0.001		<0.0015		<0.002		<0.0009	10.6		<0.001		4.88		0.538 J	
	11/15/04	unknown	<0.01		<0.01		<0.01			14		<0.01		6.2		0.68	
WES-04	09/13/99	unknown	<0.001		<0.001 UJ		<0.002		0.0053 J	9.23		<0.001		1.2		0.546 J	
	11/15/04	unknown	<0.01		<0.01		<0.01			26		<0.01		2.9		0.68	
GP-9	11/11/04	10 - 20								49		<0.01		3.2		0.55	
GP-11	11/02/04	7 - 17								5.1		<0.01		2.5		0.17	
GP-12	10/21/04	3 - 13								84		0.017		21		0.67	
GP-13	10/21/04	5 - 15								170		0.015		18		1	
GP-14	10/21/04	3 - 13								72		0.0056 J		4.5		0.61	
GP-15	10/21/04	6.7 - 16.7								200		0.065		35		2.8	
GP-16	10/21/04	10 - 20								240		0.032		14		3.3	
NOTE: mg/l = milligrams per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit. U = result qualified as non-detect due to blank contamination. R = result rejected upon validation.																	

Table 5-1k

Concentrations of Metals Detected in Groundwater (mg/l)
Southern Landfill Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	Nickel		Potassium		Selenium		Silver		Sodium		Thallium		Vanadium		Zinc	
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
MW-4S	06/28/95	15 - 25					<0.002		<0.01								0.23	
	07/08/99		0.14				<0.05		<0.007				<0.2				0.26	
	09/16/99		R		156		0.0061 J		<0.0004 UJ		363		<0.002		<0.0008 UJ		0.0238 J	
	03/14/01		0.0311		152		<0.0025		<0.0025		345		<0.00005		0.0223		0.018	
	11/15/04		<0.025 UJ		170 J		<0.005 UJ		<0.007 UJ		250 J		<0.01 UJ		0.03 J		<0.05 UJ	
	09/20/05		0.0244 J	0.0182 J	160	150	<0.005	<0.005	0.0007 J	<0.0011 U	240	220	<0.005	<0.005	0.02	0.02	0.02 J	0.02 J
	12/15/05		0.023 J	0.0195 J	160	150	<0.005	<0.005	<0.0034 U	<0.007	230	220	<0.005	<0.005	0.02	0.01	0.016 J	<0.05
MW-4B	06/28/95	34 - 44					<0.002		<0.01								0.04	
	07/08/99		0.21				<0.05		<0.007				<0.2				0.2	
	09/14/99		0.0998 J		68.3		0.0024 J		<0.0004 UJ		414		<0.002		<0.0008 UJ		<0.0163	
	03/14/01		0.109		77.2		<0.0025		<0.0025		362		<0.00025		<0.0025		0.0067 B	
	11/15/04		0.082		78		<0.005		<0.007		330		<0.005		<0.01		<0.05	
	09/20/05		0.067		86		<0.005		<0.007		350		<0.0035 U		0.003 J		0.012 J	
	12/15/05		0.072		85		<0.005		<0.007		330		0.0047 J		<0.002 U		<0.05	
MW-5	06/28/95	15 - 25					<0.002		<0.01								0.18	
	07/08/99		0.16				0.07		<0.007				<0.2				0.3	
	11/15/04		0.084	0.0687	130	100	<0.005	<0.005	<0.007	<0.007	380	400	<0.005	<0.005	0.01	<0.01	<0.05	<0.05
	09/20/05		0.094	0.077	120	120	<0.005	<0.005	<0.007	<0.001 U	390	360	<0.0039 U	<0.005	0.01	0.008 J	0.022 J	0.027 J
	12/14/05		0.094	0.08	130	110	<0.005	<0.005	<0.007	<0.001 U	410	340	<0.005	<0.005	0.01	0.03	0.013 J	0.012
WED-05	09/13/99	unknown	<0.001 UJ		2.04		<0.0018 UJ		<0.0005 UJ		8.94		<0.002		<0.0008		<0.0163	
	11/15/04	unknown	<0.025		2.5		<0.005		<0.007		14		<0.005		<0.01		<0.05	
WES-04	09/13/99	unknown	<0.0007		2.67		<0.0018 UJ		<0.0006 UJ		2.46		<0.002		<0.0008		<0.0163	
	11/15/04	unknown	<0.025		3		<0.005		<0.007		2.7		<0.005		<0.01		<0.05	
GP-9	11/11/04	10 - 20																
GP-11	11/02/04	7 - 17																
GP-12	10/21/04	3 - 13																
GP-13	10/21/04	5 - 15																
GP-14	10/21/04	3 - 13																
GP-15	10/21/04	6.7 - 16.7																
GP-16	10/21/04	10 - 20																

NOTE:
mg/l = milligrams per liter.
ft = feet below ground surface.
< = less than minimum reporting limit as indicated by the laboratory.
Bold indicates a concentration detected above the reporting limit.
A blank space indicates the sample was not analyzed for this constituent.
J = estimated concentration.
UJ = estimated reporting limit.
U = result qualified as non-detect due to blank contamination.
R = result rejected upon validation.

Table 5-11

**Concentrations of Other Parameters Detected in Groundwater
Southern Landfill Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

Sample Location Identifier	Sample Date	Screened Interval (ft)	Endosulfan sulfate (ug/l)	Iron, Ferrous (mg/l)	Methane (ug/l)	COD (mg/l)	Specific (mmhos/cm)	Chloride (mg/l)	Nitrate - N (mg/l)	Ammonia - N (mg/l)	Alkalinity, total (mg/l)	Hardness (mg/l)
MW-4S	06/28/95	15 - 25				9300	7400	650	0.02	204	2500	
	09/16/99		<0.1 UJ									
	03/14/01		<0.02									
	11/15/04			670	8550							
MW-4B	06/28/95	34 - 44				3200	4500	600	<0.02	14	1400	
	09/14/99		0.031 J									
	03/14/01		<0.02									
	11/15/04			24	21000							
MW-5	06/28/95	15 - 25				8100	6900	650	0.02	125	2300	
WED-05	09/13/99	unknown	<0.1									
WES-04	09/13/99	unknown	<0.1									
GP-9	11/11/04	10 - 20										74
GP-11	11/02/04	7 - 17										32
GP-12	10/21/04	3 - 13										370
GP-13	10/21/04	5 - 15										400
GP-14	10/21/04	3 - 13										170
GP-15	10/21/04	6.7 - 16.7										340
GP-16	10/21/04	10 - 20										220

NOTE:

ug/l = micrograms per liter.

mg/l = milligrams per liter.

mmhos/cm = micromhos per centimeter.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

J = estimated concentration.

UJ = estimated reporting limit.

Table 5-1m

Concentrations of VOCs Detected in Soil (ug/kg)

Southern Landfill Lobe

Remedial Investigation and Feasibility Study

Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	1,1-Dichloro ethane	1,2,4-Trimethyl benzene	1,2-Dichloro propane	4-Methyl-2-pentanone	Acetone	Benzene	Chloroethane	cis-1,2-Dichloro ethene	Ethylbenzene	Isopropyl benzene	o-Xylene	p/m-Xylene	Toluene	trans-1,2-Dichloro ethene
SS-06 (89)	10/26/89	0 - 0.42	<9		<9	<18	<18	<9	<18		<9				<9	
SS-07 (89)	10/26/89	0 - 1.5	<11		<11	<21	<21	<11	<21		<11				<11	
WED-05 (99)	08/16/99	10 - 12	<6 UJ		<6 UJ	<12 UJ	31 J	<6 UJ	<12 UJ	<6 UJ	<6 UJ				2 J	<6 UJ
SS-8 (04)	11/08/04	0 - 1	<1.4	<4.8 UJ	<3.4 UJ	<9.6	120	<0.96	<1.9	<0.96	<0.96 UJ	<0.96 UJ	<0.96 UJ	<0.96 UJ	<1.4	<1.4
<div>NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit.</div>																

Table 5-1n

Concentrations of SVOCs Detected in Soil (ug/kg)
Southern Landfill Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzoic Acid	Bis (2-Ethylhexyl) phthalate	Chrysene	Di-n-octyl phthalate	Fluoranthene	Phenanthrene	Pyrene
SS-06 (89)	10/26/89	0 - 0.42	87 J	93 J	83 J	<1800	490	83 J	79 J	170 J	63 J	140 J
SS-07 (89)	10/26/89	0 - 1.5	150 J	<510	<510	78 J	<510	<510	<510	<510	<510	<510
WED-05 (99)	08/16/99	10 - 12	<400 UJ	<400 UJ	<400 UJ		<400 UJ	<400 UJ	<400 UJ	<400 UJ	<400 UJ	<400 UJ
SS-8 (04)	11/08/04	0 - 1	<420	<420	<420	<4200	280 J	<420	<420	<420	<420	<420

NOTE:

ug/kg = micrograms per kilogram.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

J = estimated concentration.

UJ = estimated reporting limit.

Table 5-1o																					
Concentrations of Metals Detected in Soil (mg/kg)																					
Southern Landfill Lobe																					
Remedial Investigation and Feasibility Study																					
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts																					
Sample Location Identifier	Sample Date	Depth (ft)	Aluminum, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Selenium, Total	Sodium, Total	Vanadium, Total	Zinc, Total
SS-06 (89)	10/26/89	0 - 0.42	3510	8.5	34.3	<0.23	858 J	11	3.1 J	35.7 J	6680	371	1240	48.4 J	<0.11	7.9 J	227 J	<0.45 UJ	39	7.6	44 J
SS-07 (89)	10/26/89	0 - 1.5	4550	<1.08	8 J	<0.27	1360 J	8.5	<1.52 UJ	2.5 J	2880	1.7	1040	79.8 J	<0.14	<7.04	<248.44	<0.54 UJ	104	6.2	<1.62
WED-05 (99)	08/16/99	10 - 12	3530	0.9	13.3	0.19	640 J	7.3	1.2	3.8	3240	2.6	1160 J	40	<0.06	5.4	671	<0.56	145	7.6	11
SS-8 (04)	11/08/04	0 - 1	5700	5.5 J	6	<0.25	170	6.7	2.5	3.7	5700	4.2	700	29	0.013 J	4.6	200	0.32 J	<100	6.9	11
NOTE: mg/kg = milligrams per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit.																					

Table 5-1p

Concentrations of Pesticides Detected in Soil (ug/kg)
Southern Landfill Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	4,4'-DDE	gamma-Chlordane	Lindane
SS-06 (89)	10/26/89	0.42	9.1 J	3.9 J	8.9 J
SS-07 (89)	10/26/89	1.5	<25	<210	<12
WED-05 (99)	08/16/99	12	<4	<2.1	<2.1
SS-8 (04)	11/08/04	1	<16.9		<8.44
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration.					

Table 5-1q

Concentrations of VOCs and SVOCs Detected in Leachate Samples (ug/l)
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	1,1-Dichloroethane	Toluene	Benzene	Ethylbenzene	Trichloroethene	p/m-Xylene	o-Xylene	cis-1,2-Dichloroethene	Acetone	2-Butanone	4-Methyl-2-pentanone	2-Hexanone	3-Methylphenol/4-Methylphenol
LF-1 (05)	04/25/05	Surface	<0.75	<0.75	0.57	<0.5	<0.5	<0.5	<0.5	<0.5	10	<5	<5	<5	<5.8
LF-2 (05)	04/25/05	Surface	10	370	<5	17	7.8	48	20	29	110	77	110	120	910
<div>NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit.</div>															

Table 5-1r

Concentrations of Metals Detected in Leachate Samples (mg/l)
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Aluminum, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Nickel, Total	Potassium, Total	Sodium, Total	Vanadium, Total	Zinc, Total
LF-1 (05)	04/25/05	Surface	6.4	0.044	0.23	<0.002	130	0.06	0.01	0.04	90	0.061	23	1.5	<0.025	28	29	0.01	0.1
LF-2 (05)	04/25/05	Surface	2.6	0.018	0.08	0.004	83	0.01	0.03	0.03	370	0.016	5	2.2	0.047	7	7.5	<0.01	0.09
NOTE: mg/l = milligrams per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit.																			

Table 5-2a
Summary of Post-Excavation Base Sample Results
Remedial Investigation and Feasibility Study
Former Drum Disposal Area
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Benzene	Trichloroethene	Toluene	Tetrachloroethene	Chlorobenzene	Ethylbenzene	m&p Xylene	o-Xylene
SS-11	07/24/00	0.697 U	0.679 U	640	17	0.679 U	140	470	130
SS-12	07/24/00	0.168 U	0.34	260	8.1	0.168 U	40	210	68
SS-22	07/26/00	0.184 U	0.184 U	0.30	0.184 U	0.184 U	0.29	0.51	0.184 U
SS-30	08/02/00	1.23 U	3.1	3,600	1.9	1.23 U	390	1,200	480
SS-37	08/04/00	1.39 U	1.39 U	960	7.7	1.39 U	180	480	140
SS-49	08/09/00	0.36 U	0.36 U	150	0.36 U	0.36 U	59	180	55
SS-62	08/21/00	0.329 U	0.329 U	150	0.329 U	0.329 U	110	670	210
SS-68	08/22/00	0.341 U	0.341 U	0.341 U	0.341 U	0.341 U	0.44	0.99	0.341 U
SS-84	08/30/00	16.4 U	16.4 U	1,940	16.4 U	16.4 U	715	986	240
SS-101	09/05/00	5.72 U	5.72 U	480	7.7	5.72 U	138	438	138
SS-104	09/06/00	12.8	1,459	22,280	848	10.6 U	8,367	27,163	8,688
SS-114	09/08/00	0.07 U	0.07 U	0.72	0.013	0.07 U	0.27	0.74	0.35
SS-129	09/14/00	6.09 U	6.09 U	556	8.1	6.09 U	720	2,367	884
SS-130	09/18/00	0.096 U	0.096 U	0.096 U	0.096 U	0.096 U	0.096 U	0.192 U	0.096 U
SS-226	11/02/00	16.1 U	16.1 U	1,029.90	16.1 U	16.1 U	885.8	3,478	953.5
SS-227	11/02/00	0.281 U	0.281 U	0.281 U	0.281 U	0.281 U	0.281 U	0.562 U	0.281 U
SS-233	11/03/00	0.121 U	0.121 U	19.10	0.121 U	0.121 U	2.7 U	5.9	1.9
SS-237	11/07/00	0.068 U	0.068 U	0.068 U	0.068 U	0.068 U	0.068	0.23	0.068 U
SS-246	11/08/00	0.648 U	0.648 U	40.00	0.648 U	0.648 U	21	94.2	30.7
SS-247	11/08/00	1.36 U	1.36 U	38.50	1.36 U	1.36 U	15.9	150.5	308.1
Notes: All results in milligrams per kilogram (mg/kg) U = Contaminant not detected at reported limit									

Table 5-2b

Concentrations of VOCs Detected in Soil (ug/kg)
Former Drum Disposal Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	1,1,1-Trichloroethane	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	Acetone	Ethylbenzene	Isopropylbenzene	n-Butylbenzene	n-Propylbenzene	o-Xylene	p/m-Xylene	p-Isopropyltoluene	Tetrachloroethene	Toluene
SB-1 (04)	10/05/04	4 - 5	<0.79	9.8 J	<4 UJ	24 J	1.8 J	0.94 J	13 J	1.2 J	4.1 J	4.9 J	2.4 J	<0.79	2.5
SB-2 (04)	10/08/04	8 - 10	<0.7	<3.5	<3.5	8.3	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<1
SB-3 (04)	10/08/04	0 - 2	<120	6300	2400	<1200 UJ	6200	350	730	700	4600	20000	370	<120	6500
SB-4 (04)	10/06/04	5 - 7	<2500	160000	58000	<25000	120000	12000	13000	26000	170000	460000	6400	<2500	69000
SB-5 (04)	10/08/04	4 - 6	<1100	75000	26000	<11000	79000	6600	6800	16000	82000	240000	3000	<1100	51000
SB-6 (04)	10/06/04	4 - 5	420000	590000	200000	<98000	400000	39000	54000	82000	400000	1100000	26000	27000	710000

NOTE:

ug/kg = micrograms per kilogram.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

J = estimated concentration.

UJ = estimated reporting limit.

Table 5-2c

Concentrations of SVOCs Detected in Soil (ug/kg)
Former Drum Disposal Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Anthracene	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(e) Pyrene	Benzo(ghi) perylene	Benzo(k) fluoranthene	Bis(2-Ethylhexyl) phthalate	Butyl benzyl phthalate	Chrysene	Di-n-octylphthalate	Fluoranthene	Indeno(1,2,3-cd) Pyrene	Naphthalene	Phenanthrene	Pyrene
SB-1 (04)	10/05/04	4 - 5	430	1100	1100	840	760	800	960	3600	<430	1200	980	2400	720	24 J	1600	2100
SB-2 (04)	10/08/04	8 - 10	<430	<430	<430	<430	<430	<430	<430	<860	<430	<430	<430	<430	<430	<3.5	<430	<430
SB-3 (04)	10/08/04	0 - 2	<410	<410	<410	<410	<410	<410	<410	120000	<410	<410	39000	<410	<410	1400	<410	<410
SB-4 (04)	10/06/04	5 - 7	<400	<400	<400	<400	<400	<400	<400	55000	1100	<400	26000	<400	<400	26000	<400	<400
SB-5 (04)	10/08/04	2 - 4	<370	<370	<370	<370	<370	<370	<370	190000	2300	<370	95000	370	<370	500	<370	<370
SB-6 (04)	10/06/04	4 - 5	<7600	<7600	<7600	<7600	<7600	<7600	<7600	1500000	<7600	<7600	1600000	<7600	<7600	100000	<7600	<7600
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration.																		

Table 5-2d

Concentrations of Metals Detected in Soil (mg/kg)
Former Drum Disposal Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Aluminum, Total	Arsenic, Total	Barium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Vanadium, Total	Zinc, Total
SB-1 (04)	10/05/04	5 - 6	7400	6.7	35	0.45	16	4.4	25	10000	73	2500	140	0.17	12	16	65
SB-2 (04)	10/08/04	10 - 12	4000	4.2	<9.9 U	<0.25	7.3	1.7	<2.9 U	3100	<2.5	<1100 U	38	<0.09	4.4	6.2	<6.7 U
SB-3 (04)	10/08/04	4 - 6	4000	5.2	<8.5 U	<0.26	8.1	1.7	<3.6 U	3700	4.6	<1200 U	41	<0.1	4.5	6.1	<9 U
SB-4 (04)	10/06/04	7 - 8	3900	4.3	12	<0.24	8.8	3.4	<4.5 U	5500	<2.4	1800	68	<0.1	8.7	7.8	25
SB-5 (04)	10/08/04	2 - 4	6400	5.5	26	3.8	19	3.9	21	9400	69	2100	130	0.11	8.8	14	48
SB-6 (04)	10/06/04	5 - 7	4600	4.9	<9.1 U	<0.24	15	2.3	<3.9 U	5700	<2.4	2500	62	<0.1	6.8	10	<16 U

NOTE:

mg/kg = milligrams per kilogram.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

U = laboratory result qualified as less than the indicated limit based on blank contamination.

J = estimated concentration.

Table 5-2e

Concentrations of VOCs Detected in Groundwater (ug/l)
Former Drum Disposal Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	1,1,1-Trichloro ethane	1,1,2-Trichloro ethane	1,1-Dichloro ethane	1,1-Dichloro ethene	1,2,4-Trimethyl benzene	1,2-Dichloro benzene	1,2-Dichloro ethane	1,3,5-Trimethyl benzene	1,4-Dioxane	2-Butanone
DEP-2	06/02/99	unknown	<2500	<2500	<2500	<480	<2500	<500	<2500	<2500		
DEP-3	06/02/99	unknown	7.05	<5	17.8	<0.96	<5	<5	<5	<5		
MW-7S	06/30/99	0 - 10	10.9	5.41	79.6	<0.96	<5	<1	<5	<5		
	11/17/04		<0.5	<0.75	2.8	0.4 J	<2.5	<2.5 UJ	<0.5	<2.5	<5	<5
MW-7M	06/29/95	15 - 25	44		360		320		3.8			
	06/02/99		<5	<5	9.06	<0.96	189	2.04	6.87	53.2		
	06/30/99		<5	<5	24.5	<0.96	236	<1	<5	65.4		
	11/17/04		<50	<75	<75	<50	1200	<25	<50	350	760	<500
MW-7R	07/01/99	37 - 47	<5	<5	<5	<0.96	<5	<1	<5	<5		
	11/17/04		<0.5	<0.75	0.45 J	<0.5	<2.5	<2.5	<0.5	<2.5	<5	<5
MW-9	06/23/99	15 - 25	152	<5	226	114	702	<5	<5	220		
	06/30/99		707	<50	<50	<9.6	1450	<5	<50	<50		
	09/17/99		<20000 UJ	<20000	<20000	<20000 UJ		<100	<20000			330000
	11/17/04		<2500	<3800	<3800	<2500	<12000	<250	<2500	<12000	<10000	66000
	09/21/05		<2500	<3800	<3800	<2500	<12000	<1000	<2500	<12000	3000 J	65000
	12/19/05		<2500	<3800	<3800	<2500	<12000	<1000	<2500	<12000	2800 J	64000

NOTE:
 ug/l = micrograms per liter.
 ft = feet below ground surface.
 < = less than minimum reporting limit as indicated by the laboratory.
Bold indicates a concentration detected above the reporting limit.
 A blank space indicates the sample was not analyzed for this constituent.
 J = estimated concentration.
 UJ = estimated reporting limit.
 R = result rejected upon validation.

Table 5-2e

Concentrations of VOCs Detected in Groundwater (ug/l)
Former Drum Disposal Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	4-Methyl-2-pentanone	Acetone	Benzene	Chloroethane	Ethyl benzene	Isopropyl benzene	Methylene chloride	n-Propyl benzene	o-Xylene	p/m-Xylene	Styrene
DEP-2	06/02/99	unknown			<2500	<2500	2590	<2500	<5000	<2500			<2500
DEP-3	06/02/99	unknown			<5	<5	<5	<5	<10	<5			<5
MW-7S	06/30/99	0 - 10			<5	<5	<5	5.82	<10	<5			<5
	11/17/04		<5	<5	<0.5	<1	<0.5	<0.5	<5	<0.5	<0.5	<0.5	<0.5
MW-7M	06/29/95	15 - 25			8.4		620			46			
	06/02/99				6.16	360	450	18.4	10.7	24.4			<5
	06/30/99				6.04	<5	821	20.2	<10	30.4			<5
	11/17/04		<500	<500	<50	2200	3700	57	<500	82	3000	8000	<50
MW-7R	07/01/99	37 - 47			<5	<5	<5	<5	<10	<5			<5
	11/17/04		<5	<5	<0.5	<1	<0.5	<0.5	<5	<0.5	<0.5	0.43 J	<0.5
MW-9	06/23/99	15 - 25			271	<5	7650	87.8	851	128			<5
	06/30/99				<50	<50	5710	<50	2020	<50			<50
	09/17/99		770000 J	170000		R <20000	12000 J		<20000				2600 J
	11/17/04		160000	59000	<2500	<5000	4400	<2500	<25000	<2500	3200	9000	<2500
	09/21/05		160000	56000	<2500	<5000	6200	<2500	<25000 U	<2500	4500 J	15000	<2500
	12/19/05		190000	68000	<2500	<5000	4000 J	<2500	2200 J	<2500	4900 J	9500 J	<2500

NOTE:

ug/l = micrograms per liter.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

J = estimated concentration.

UJ = estimated reporting limit.

R = result rejected upon validation.

Table 5-2e

Concentrations of VOCs Detected in Groundwater (ug/l)
Former Drum Disposal Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	tert-Butylbenzene	Tetrachloro ethene	Tetra hydrofuran	Toluene	Trichloro ethene	Vinyl chloride	Xylenes (total)
DEP-2	06/02/99	unknown	<2500	<2500		39600	<2500	<1000	10400
DEP-3	06/02/99	unknown	<5	<5		<5	11.6	<2	<5
MW-7S	06/30/99	0 - 10	<5	<5		5.55	<5	<2	7.51
	11/17/04		<2.5	<0.5	<10	<0.75	<0.5	<1	
MW-7M	06/29/95	15 - 25		3.4		1500	2.9	16	1300
	06/02/99		29.9	<5		1410	<5	<2	8920
	06/30/99		<5	<5		2720	<5	<2	1720
	11/17/04		<250	<50	1200	66 J	<50	<100	
MW-7R	07/01/99	37 - 47	<5	<5		<5	<5	<2	<5
	11/17/04		<2.5	<0.5	<10	<0.75	<0.5	<1	
MW-9	06/23/99	15 - 25	<5	96.7		58000	55.8	28.6	30200
	06/30/99		<50	<50		85000	<50	<20	22200
	09/17/99			<20000		160000 J	<20000 UJ	<20000	49000 J
	11/17/04		<12000	<2500	17000 J	40000	<2500	<5000	
	09/21/05		<12000	<2500	20000 J	78000	<2500	<5000	
	12/19/05		<12000	<2500	18000 J	56000 J	<2500	<5000	

NOTE:
ug/l = micrograms per liter.
ft = feet below ground surface.
< = less than minimum reporting limit as indicated by the laboratory.
Bold indicates a concentration detected above the reporting limit.
A blank space indicates the sample was not analyzed for this constituent.
J = estimated concentration.
UJ = estimated reporting limit.
R = result rejected upon validation.

Table 5-2f

Concentrations of SVOCs Detected in Groundwater (ug/l)
Former Drum Disposal Area
Remedial Investigation and Feasability Study
Sutton Brook Disposal Area Auperfund Site

Sample Location Identifier	Sample Date	Screened Interval (ft)	2,4-Dimethyl phenol	2-Methyl phenol	2-Nitrophenol	3-Methylphenol/ Methylphenol	4-Methyl phenol	Benzoic Acid	Benzyl Alcohol	Bis(2-Ethylhexyl) phthalate	Dimethyl phthalate	Naphthalene	Phenol
DEP-2	06/02/99	unknown	<1880	586	<250	<750		<5000	<500	<1000	<875	<375	10900
MW-7S	06/30/99	0 - 10	<3.75	<1	<0.5	<1.5		<10	<1	<2	<1.75	<0.75	<0.25
	11/17/04		<10	<6	<20	<6		<50	<10	<5 UJ	<5 UJ	<2.5 UJ	<7
MW-7M	06/02/99	15 - 25	124	138	<0.5	205		15	<1	<2	<1.75	2.74	<0.25
	06/30/99		113	26.5	<0.5	59.4		<10	<1	<2	<1.75	<0.75	<0.25
	11/17/04		180	<30	<100	40		<250	<50	<25	<25	9.7 J	<35
MW-7R	07/01/99	37 - 47	<3.75	<1	<0.5	<1.5		<10	<1	<2	<1.75	<0.75	<0.25
	11/17/04		<10	<6	<20	<6		<50	<10	<5	<5	<2.5	<7
MW-9	06/30/99	15 - 25	<18.75	<5	102	102		<50	146	<10	237	<3.75	878
	09/17/99		<100	90 J	<100		94 J			<100	230 J	<100	1800 J
	11/17/04		<500	430	<1000	1200		3500	<500	610	80 J	<250	5000
	09/21/05		<2100	700 J	<4100	1700		4100 J	<2100	<1000	<1000	<1000 UJ	8100
	12/19/05		<2100	520 J	<4200	1700		3900 J	<2100	<1000	<1000	<1000	6100

NOTE:

ug/l = micrograms per liter.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

J = estimated concentration.

UJ = estimated reporting limit.

Table 5-2g

Concentrations of Metals Detected in Groundwater (ug/l)
Former Drum Disposal Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Screened Interval (ft)	Aluminum, Total	Antimony, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Cyanide, Total	Iron, Total	Lead, Total
DEP-2	06/02/99	unknown		<0.05	0.88		<0.003	0.14		<0.06		0.03			0.06
MW-7S	06/30/99	0 - 10		0.08	<0.05		0.03	0.008		<0.06		<0.008			<0.02
	11/17/04		0.36	<0.006	0.023	0.077	<0.0004 U	0.0005 J	110	<0.01	0.001 J	0.007 J		15	<0.01
MW-7M	06/29/95	15 - 25			0.115	0.62		<0.01		<0.01		0.03	<0.01	48	<0.05
	06/02/99			<0.05	0.68		<0.003	0.016		<0.06		<0.008			0.04
	06/30/99			<0.05	0.64		0.02	0.03		<0.06		0.008			<0.02
	11/17/04		0.09 J	<0.006	0.58	0.3	<0.0006 U	0.001 J	100	<0.01	0.001 J	0.1		64	0.0058 J
MW-7R	07/01/99	37 - 47		0.08	0.12		0.03	0.01		<0.06		<0.008			0.07
	11/17/04		<0.081 U	<0.006	<0.005	0.03	<0.002	<0.002	27	<0.01	<0.01	<0.01		0.17	<0.01
MW-9	06/30/99	15 - 25		<0.05	0.41		0.03	0.09		<0.06		<0.008			0.02
	09/17/99		<0.0465 UJ	<0.0025	0.563	0.191 J	R	<0.0017 UJ	164	R	0.121	<0.0101 UJ	0.005	217	<0.0065
	11/17/04		0.11	<0.006	0.313	0.19	<0.0013 U	0.0009 J	130	0.002 J	0.059	<0.01		200	<0.01
	09/21/05		0.12	<0.006	0.422	0.24	0.0004 J	<0.002	190	0.004 J	0.14	<0.01		280	<0.01
	12/19/05		0.15	<0.006	0.294	0.25	0.004 J	0.002	190	<0.01	0.12	<0.01		280	<0.01
NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. R = result rejected upon validation. U = laboratory result qualified as less than the indicated limit based on blank contamination. J = estimated concentration. UJ = estimated reporting limit.															

Table 5-2g

Concentrations of Metals Detected in Groundwater (ug/l)
Former Drum Disposal Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Screened Interval (ft)	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Silver, Total	Sodium, Total	Vanadium, Total	Zinc, Total
DEP-2	06/02/99	unknown			<0.0005	0.12		<0.007			0.24
MW-7S	06/30/99	0 - 10			<0.0005	<0.01		<0.007			0.02
	11/17/04		16	0.77	0.00007 J	0.0033 J	30	<0.007	25	0.001 J	0.036 J
MW-7M	06/29/95	15 - 25		4.2	<0.0002			<0.01			0.09
	06/02/99				<0.0005	<0.01		<0.007			0.07
	06/30/99				<0.0005	0.01		0.02			0.01
	11/17/04		24	2.6	<0.0002	0.0064 J	73	<0.007	100	0.004 J	0.044 J
MW-7R	07/01/99	37 - 47			<0.0005	<0.01		0.03			<0.01
	11/17/04		2.4	0.047	<0.0002	<0.025	4.4	<0.007	14	<0.01	<0.05
MW-9	06/30/99	15 - 25			<0.0005	0.03		<0.007			0.11
	09/17/99		12.4	13.9	<0.00005	<0.0276 UJ	35.2	0.0536	36.7	<0.0238 UJ	<0.0139 UJ
	11/17/04		12	29	0.00002 J	0.0203 J	41	<0.0007 U	32	0.006 J	0.013 J
	09/21/05		13	17	0.00002 J	0.058	49	0.0012 J	54	0.01	0.023 J
	12/19/05		12	18	<0.0002	0.052	53	0.0014 J	56	0.009 J	0.015 J
NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. R = result rejected upon validation. U = laboratory result qualified as less than the indicated limit based on blank c J = estimated concentration. UJ = estimated reporting limit.											

Table 5-2h

Concentrations of Petroleum Hydrocarbons Detected in Groundwater (ug/l)
Former Drum Disposal Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Screened Interval (ft)	C11-C22 Aromatic Hydrocarbons	C5-C8 Aliphatic Hydrocarbons	C9-C10 Aromatic Hydrocarbons	C9-C12 Aliphatic Hydrocarbons	C9-C18 Aliphatic Hydrocarbons
DEP-2	06/02/99	unknown	10400	770000	8330	48400	3510
DEP-3	06/02/99	unknown		<40	<55	<15	
MW-7M	06/02/99	15 - 25	136	6250	1740	4090	130
NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent.							

Table 5-2i

Concentrations of VOCs and SVOCs Detected in Soil (ug/kg)
Adjacent Disturbed Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	2-Hexanone	Acetone	Benzene	Toluene	Bis (2-ethylhexyl) phthalate
GP-23 (04)	11/09/04	0 - 1	2.7 J	55	<0.64	110	
SS-13 (04)	11/08/04	0 - 1	<8.6	82 J	0.54 J	17 J	
SS-14 (04)	11/09/04	0 - 1	<6.9	25	<0.69	<1	
SS-12(04)	11/09/04	0 - 1	<7.5	11	<0.75	12	270 J
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. J = estimated concentration.							

Table 5-2j

Concentrations of Metals Detected in Soil (mg/kg)
Adjacent Disturbed Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Aluminum, Total	Antimony, Total	Arsenic, Total	Barium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Selenium, Total	Silver, Total	Sodium, Total	Vanadium, Total	Zinc, Total
GP-23 (04)	11/09/04	0 - 1	6200	<2.5	7.1 J	10	280	10	2.7	4.4	5300	3.8	1400	58	<0.1	6.7	520	0.24 J	<0.1 U	<99	9.5	11
SS-13 (04)	11/08/04	0 - 1	5900	0.29 J	4.6 J	9	190	5.1	1.1	2.6	3000	33	570	15	0.049 J	3.1	380	0.49 J	<0.55	240	6.3	5.1
SS-14 (04)	11/09/04	0 - 1	10000	<2.4	16 J	31	190	15	4.9	8.9	12000	8.1	2300	130	<0.09	8.4	1700	0.35 J	1.1	<94	16	22
SS-12 (04)	11/09/04	0 - 1	3900		6 J	9.4	610	6.2	2.1	3.6	3600	1.9 J	1000	43		4.2	420			38 J	6.3	7.2

NOTE:

mg/kg = milligrams per kilogram.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

U = Laboratory result qualified as less than indicated limit based on blank contamination.

J = estimated concentration.

Table 5-2k

**Concentrations of Pesticides Detected in Soil (ug/kg)
Adjacent Disturbed Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site**

Sample Location Identifier	Sample Date	Depth (ft)	4,4'-DDD	4,4'-DDE	4,4'-DDT
GP-23 (04)	11/09/04	0 - 1	<16.7	<16.7	<16.7
SS-13 (04)	11/08/04	0 - 1	44	38.1	6.02 J
SS-14 (04)	11/09/04	0 - 1	<3.17	<3.17	<3.17
SS-12 (04)	11/09/04	0 - 1	<18	<18	<18
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. J = estimated concentration.					

Table 5-21

**Concentrations of pH and TOC Detected in Soil
Adjacent Disturbed Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site**

Sample Location Identifier	Sample Date	Depth (ft)	pH (SU)	Total Organic Carbon (%)
GP-23 (04)	11/09/04	0 - 1	5.8	0.759
SS-13 (04)	11/08/04	0 - 1	6.7	2.72
SS-14 (04)	11/09/04	0 - 1	5.3	0.412
SS-12 (04)	11/09/04	0 - 1	6.5	0.214
NOTE: SU = standard units. % = percent. ft = feet below ground surface. Bold indicates a concentration detected above the reporting limit.				

Table 5-2m

Concentrations of VOCs Detected in Groundwater (ug/l)
Adjacent Disturbed Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Screened Interval (ft)	1,1,1-Trichloro ethane	1,1-Dichloro ethane	1,1-Dichloro ethene	1,2,4-Trichloro benzene	1,2-Dichloro benzene	1,2-Dichloro ethane	1,2-Dichloro propane	1,4-Dichloro benzene	1,4-Dioxane	Benzene	Carbon disulfide	Chlorobenzene	Chloroethane	Chloromethane
MW-10	06/30/99	15 - 25	<5	<5	<0.96	<0.75	<1	<5	<5	<1		<5		<5	<5	<5
	03/15/01		<1	<1	<1	<1	<1	<1	<1	<1	<50 UJ	0.14 J	<5.7 UJ	<1	<1	<1 UJ
	11/17/04		0.58	0.65 J	1.5	<2.5	<2.5	<0.5	<1.8	<2.5	5.1	<0.5	<5	<0.5	<1	<2.5
MW-16B	03/16/01	50 - 60	<1	<1	<1	<1	<1	<1	<1	<1	<50 UJ	<1	<5.7 UJ	<1	<1	<1
	11/18/04		<0.5	<0.75	<0.5	<2.5	<2.5	<0.5	<1.8	<2.5	<5	<0.5	<5	<0.5	<1	0.5 J
MW-16D	03/16/01	28 - 38	<1	0.36 J	<1	<1	<1	<1	<1	<1	68 J	0.25 J	<5.7 UJ	0.2 J	<1	<1
	11/18/04		<0.5	<0.75	<0.5	<2.5	<2.5	<0.5	<1.8	<2.5	5	<0.5	<5	<0.5	<1	<2.5
DEP-1	06/02/99	unknown	<5	<5	<0.96	<5	<5	<5	<5	<5		<5		<5	<5	<5
GP-23	11/11/04	15 - 25	<0.5	<0.75	<0.5	<2.5	<2.5	<0.5	<1.8	<2.5	<5	<0.5	<5	<0.5	<1	<2.5
GP-24	11/04/04	18 - 28	<0.5	0.64 J	<0.5	<2.5	<2.5	<0.5	<1.8	<2.5	1.6 J	<0.5	<5	<0.5	<1	<2.5
GP-25	11/11/04	15 - 25	<0.5	1.5	<0.5	0.4 J	0.36 J	0.38 J	0.35 J	1.1 J	180	3.6	0.7 J	3.7	1.8	<2.5
<div>NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit.</div>																

Table 5-2m

Concentrations of VOCs Detected in Groundwater (ug/l)
Adjacent Disturbed Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Screened Interval (ft)	cis-1,2-Dichloro ethene	Dichlorodifluoro methane	Ethyl Ether	Isopropyl benzene	Methyl tert butyl ether	sec-Butyl benzene	Tetrachloro ethene	Tetra hydrofuran	Toluene	Trichloro ethene	Trichloro fluoromethane	Vinyl chloride
MW-10	06/30/99	15 - 25	<5	<5		<5		<5	<5		<5	<5	<5	<2
	03/15/01		0.25 J	<2.8 UJ	<25 UJ	<1	<25 UJ	0.07 J	<1	3.8 J	<1	<1	<1	<1
	11/17/04		<0.5	12	<2.5	<0.5	<1	<0.5	<0.5	2 J	4.2	<0.5	<2.5	<1
MW-16B	03/16/01	50 - 60	<1	<1	<25 UJ	<1	<25 UJ	<1	<1	<50 UJ	<1	<1	<1	<1
	11/18/04		<0.5	<5	<2.5	<0.5	<1	<0.5	<0.5	<10	0.32 J	<0.5	<2.5	<1
MW-16D	03/16/01	28 - 38	0.24 J	<1	1.3 J	0.11 J	<25 UJ	<1	0.22 J	3.4 J	<1	0.1 J	<1	<1
	11/18/04		<0.5	<5	0.42 J	<0.5	<1	<0.5	<0.5	<10	<0.75	<0.5	0.33 J	<1
DEP-1	06/02/99	unknown	<5	<5		<5		<5	<5		<5	<5	<5	<2
GP-23	11/11/04	15 - 25	<0.5	<5	<2.5	<0.5	5	<0.5	<0.5	<10	<0.75	<0.5	<2.5	<1
GP-24	11/04/04	18 - 28	0.48 J	<5	0.88 J	<0.5	<1	<0.5	<0.5	<10	<0.75	0.39 J	<2.5	<1
GP-25	11/11/04	15 - 25	1.4	<5	19	1.4	0.83 J	<0.5	<0.5	44	<0.75	<0.5	<2.5	0.44 J
<p>NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit.</p>														

Table 5-2n

Concentrations of SVOCs Detected in Groundwater (ug/l)
Adjacent Disturbed Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Screened Interval (ft)	Naphthalene
MW-10	06/30/99	15 - 25	<0.75
	03/15/01		<1 UJ
	11/17/04		<2.5
MW-16B	03/16/01	50 - 60	0.49 J
	11/18/04		<2.5
MW-16D	03/16/01	28 - 38	<1
	11/18/04		<2.5
DEP-1	06/02/99	unknown	<50
GP-23	11/11/04	15 - 25	<2.5
GP-24	11/04/04	18 - 28	<2.5
GP-25	11/11/04	15 - 25	<2.5
NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. J = estimated concentration. UJ = estimated reporting limit.			

Table 5-2o

**Concentrations of PCBs and Pesticides Detected in Groundwater (ug/l)
Adjacent Disturbed Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site**

Sample Location Identifier	Sample Date	Screened Interval (ft)	Aroclor 1254
MW-10	03/15/01	15 - 25	<0.2
MW-16B	03/16/01	50 - 60	<0.2
MW-16D	03/16/01	28 - 38	1.2 J
<p>NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. J = estimated concentration.</p>			

Table 5-2p

Concentrations of Metals and Hardness Detected in Groundwater (mg/l)
Adjacent Disturbed Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Screened Interval (ft)	Aluminum, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total
MW-10	06/30/99	15 - 25		<0.05		0.03	0.01		0.15		0.01
	03/15/01		<0.0075	0.0056	0.0773	<0.0005	<0.0001	33.9	<0.0025	<0.0025	<0.0025
	11/17/04		0.032 U	0.018	0.046	<0.002	<0.002	32	<0.01	0.001 J	<0.01
MW-16B	11/18/04	50 - 60	0.18	<0.005	0.16	<0.002	<0.002	230	<0.01	<0.01	<0.01
	03/16/01		0.479	0.0105	0.284	<0.0005	<0.0001	366	<0.0025	<0.0025	<0.0025
MW-16D	11/18/04	28 - 38	<0.1	0.109	0.036	<0.002	<0.002	39	<0.01	<0.01	<0.01
	03/16/01		0.105	0.172	0.0503	<0.0005	<0.0001	42.7	<0.0025	<0.0025	<0.0025
GP-23	11/11/04	15 - 25		<0.005			<0.002				
GP-24	11/04/04	18 - 28		0.011			<0.002				
GP-25	11/11/04	15 - 25		0.014			0.002 J				

NOTE:

mg/l = milligrams per liter.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

U = Laboratory result qualified as less than indicated limit based on blank contamination.

B = Analyte also detected in a blank sample.

J = estimated concentration.

UJ = estimated reporting limit.

Table 5-2p

Concentrations of Metals and Hardness Detected in Groundwater (mg/l)
Adjacent Disturbed Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Screened Interval (ft)	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Nickel, Total	Potassium, Total	Selenium, Total	Silver, Total	Sodium, Total
MW-10	06/30/99	15 - 25		0.03			0.2		0.18	<0.007	
	03/15/01		1.01	<0.0015	3.95	1.65	<0.0025	4.08	<0.0025	<0.0025	137
	11/17/04		4.3	<0.01	3.8	1.6	<0.025	3.1	<0.005 UJ	<0.007	45
MW-16B	11/18/04	50 - 60	0.71	<0.01	0.83	0.02	<0.025	8.6	<0.005	<0.007	35
	03/16/01		0.0541	<0.0015	1.39	0.0336	<0.0025	12.2	<0.0025	<0.0025	23.1
MW-16D	11/18/04	28 - 38	6.3	<0.01	11	1.1	<0.025	8.9	<0.005	<0.007	33
	03/16/01		7.33	<0.0015	10.9	1.26	<0.0025	8.93	<0.0025	<0.0025	62.8
GP-23	11/11/04	15 - 25	1	<0.01	3.1	0.55					
GP-24	11/04/04	18 - 28	17	<0.01	15	3.8					
GP-25	11/11/04	15 - 25	12	<0.01	48	15					

NOTE:

mg/l = milligrams per liter.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

U = Laboratory result qualified as less than indicated limit based on blank contamination.

B = Analyte also detected in a blank sample.

J = estimated concentration.

UJ = estimated reporting limit.

Table 5-2p

Concentrations of Metals and Hardness Detected in Groundwater (mg/l)
Adjacent Disturbed Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Screened Interval (ft)	Thallium, Total	Vanadium, Total	Zinc, Total	Hardness
MW-10	06/30/99	15 - 25	<0.2		0.12	
	03/15/01		0.00005 B	<0.0025	<0.0025	
	11/17/04		<0.005	<0.01	<0.05	
MW-16B	11/18/04	50 - 60	<0.005	<0.01	<0.05	
	03/16/01		<0.00005	<0.0025	<0.0025	
MW-16D	11/18/04	28 - 38	<0.005	<0.01	<0.05	
	03/16/01		<0.00005	<0.0025	<0.0029 UJ	
GP-23	11/11/04	15 - 25				30
GP-24	11/04/04	18 - 28				180
GP-25	11/11/04	15 - 25				450
<p>NOTE: mg/l = milligrams per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. U = Laboratory result qualified as less than indicated limit based on blank contamination. B = Analyte also detected in a blank sample. J = estimated concentration. UJ = estimated reporting limit.</p>						

Table 5-3a

**Concentrations of VOCs Detected in Soil (ug/kg)
Former Residence, Garage, and Storage Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site**

Sample Location Identifier	Sample Date	Depth (ft)	1,2,4-Trichloro benzene	2-Butanone	Acetone	Benzene	Carbon disulfide	Ethyl benzene	Hexachloro butadiene	Isopropyl benzene	n-Butyl benzene
SO-01 (99)	08/04/99	0 - 0.5	<340	<10 UJ	<28 UJ	<5 UJ	<5 UJ	<5 UJ	<340		
SO-02 (99)	08/04/99	0 - 0.5	<350	<11 UJ	<11 UJ	<6	<6	<6	<350		
SO-04 (99)	08/04/99	0 - 0.5	<360	<11 UJ	120 J	<6 UJ	<6 UJ	<6 UJ	<360		
SO-05 (99)	08/04/99	0 - 0.5	<350	25	270 J	<5	1 J	<5 UJ	<350		
SO-06 (99)	08/04/99	0 - 0.5	<340	<11 UJ	<29 UJ	<5 UJ	<5 UJ	<5 UJ	<340		
SO-07 (99)	08/04/99	0 - 0.5	560	<11 UJ	190 J	<6	<6	<6	550		
SO-08 (99)	08/04/99	0 - 0.5	<340	<11 UJ	150 J	<6	<6	<6	<340		
SO-09 (99)	08/04/99	0 - 0.5	74 J	<11 UJ	<37 UJ	<5	<5	0.8 J	72 J		
SO-10 (99)	08/04/99	0 - 0.5	54 J	<10 UJ	120 J	28	<5	<5	50 J		
WED-07 (99)	08/18/99	15 - 17	<420 UJ	<10	50 J	<5	<5 UJ	<5	<420 UJ		
SB-7 (04)	10/05/04	1.5 - 2	<6.3	<13	33	<1.3	<13	<1.3	<6.3	<1.3	<1.3
		2 - 2	<360						<720		
SB-8 (04)	10/04/04	2 - 2.5	<4400						<8800		
		2.5 - 2.5	<590	<1200	<1200	<120	<1200	700	<590	210	540
SB-9 (04)	10/04/04	2.5 - 2.5	<370						<750		
		2.8 - 2.8	<3.5 UJ	<7	22 J	4.4 J	<7	0.95 J	<3.5 UJ	<0.7 UJ	<0.7 UJ
SB-10 (04)	10/04/04	4 - 5	<460						<910		
		7.5 - 7.5	R	120 J	330 J	19 J	R	20 J	R	15 J	R
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit. R = result rejected upon validation.											

Table 5-3a

**Concentrations of VOCs Detected in Soil (ug/kg)
Former Residence, Garage, and Storage Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site**

Sample Location Identifier	Sample Date	Depth (ft)	n-Propyl benzene	o-Xylene	p/m-Xylene	p-Isopropyl toluene	Styrene	Toluene	Xylenes (total)
SO-01 (99)	08/04/99	0 - 0.5		<500	<500		<5 UJ	<5 UJ	<5 UJ
SO-02 (99)	08/04/99	0 - 0.5		<450	<450		<6	0.6 J	<6
SO-04 (99)	08/04/99	0 - 0.5		<490	<490		<6 UJ	<6 UJ	<6 UJ
SO-05 (99)	08/04/99	0 - 0.5		<480	<480		<5 UJ	<5 UJ	<5 UJ
SO-06 (99)	08/04/99	0 - 0.5		<500	<500		<5 UJ	<5 UJ	<5 UJ
SO-07 (99)	08/04/99	0 - 0.5		<380	<380		<6	<6	<6
SO-08 (99)	08/04/99	0 - 0.5		<460	<460		<6	<6	<6
SO-09 (99)	08/04/99	0 - 0.5		<550	860		<5	21	20
SO-10 (99)	08/04/99	0 - 0.5		<760	<760		<5	3 J	<5
WED-07 (99)	08/18/99	15 - 17					<5	<5	<5
SB-7 (04)	10/05/04	1.5 - 2	<1.3	<1.3	<1.3	<1.3	<1.3	<1.9	
		2 - 2							
SB-8 (04)	10/04/04	2 - 2.5							
		2.5 - 2.5	240	260	700	270	740	230	
SB-9 (04)	10/04/04	2.5 - 2.5							
		2.8 - 2.8	<0.7 UJ	1.4 J	2.8 J	<0.7 UJ	<0.7 UJ	3.2 J	
SB-10 (04)	10/04/04	4 - 5							
		7.5 - 7.5	5 J	19 J	21 J	R	R	27 J	

NOTE:
ug/kg = micrograms per kilogram.
ft = feet below ground surface.
< = less than minimum reporting limit as indicated by the laboratory.
Bold indicates a concentration detected above the reporting limit.
A blank space indicates the sample was not analyzed for this constituent.
J = estimated concentration.
UJ = estimated reporting limit.
R = result rejected upon validation.

Table 5-3b

Concentrations of SVOCs Detected in Soil (ug/kg)
Former Residence, Garage, and Storage Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	1-Methyl naphthalene	2,4,6-Trichloro phenol	2,4-Dichloro phenol	2,4-Dimethyl phenol	2,4-Dinitro phenol	2,6-Dinitro toluene	2-Chloro naphthalene	2-Chloro phenol	2-Methyl naphthalene	2-Nitrophenol	3,3'-Dichloro benzidine	4,6-Dinitro-o-cresol	4-Nitrophenol	Acenaphthene	Acenaphthylene
SO-01 (99)	08/04/99	0 - 0.5		<340	<340	<340	<850	<340	<340	<340	<340	<340	<340	<850	<850	<340	<340
SO-02 (99)	08/04/99	0 - 0.5		<350	<350	<350	<870	<350	<350	<350	<350	<350	<350	<870	<870	<350	<350
SO-04 (99)	08/04/99	0 - 0.5		<360	<360	<360	<900	<360	<360	<360	<360	<360	<360	<900	<900	<360	<360
SO-05 (99)	08/04/99	0 - 0.5		<350	<350	<350	<880	<350	<350	<350	<350	<350	<350	<880	<880	<350	<350
SO-06 (99)	08/04/99	0 - 0.5		<340	<340	<340	<850	<340	<340	<340	<340	<340	<340	<850	<850	<340	<340
SO-07 (99)	08/04/99	0 - 0.5		390	280 J	89 J	68 J	220 J	190 J	440	<350	280 J	<350	250 J	220 J	53 J	<350
SO-08 (99)	08/04/99	0 - 0.5		<340	<340	<340	<860	<340	<340	<340	<340	<340	340	<860	<860	83 J	<340
SO-09 (99)	08/04/99	0 - 0.5		43 J	<350	<350	<870	<350	<350	<350	280 J	<350	<350	<870	<870	<350	<350
SO-10 (99)	08/04/99	0 - 0.5		<370	<370	<370	<930 UJ	<370	<370	<370	<370	<370	<370	<930	<930	87 J	<370
WED-07 (99)	08/18/99	15 - 17		<420 UJ	<420 UJ	<420 UJ	<1000 UJ	<420 UJ	<420 UJ	<420 UJ	<420 UJ	<420 UJ	<420 UJ	<1000 UJ	<1000 UJ	<420 UJ	<420 UJ
SB-7 (04)	10/05/04	2 - 2	<360	<360	<720	<720	<1400	<360	<14	<430	<580	<1400	<3600	<1400	<720	<360	<360
SB-8 (04)	10/04/04	2 - 2.5	12000	<4400	<8800	<8800	<18000	<4400	<1800	<5300	17000	<18000	<44000	<18000	<8800	25000	<4400
SB-9 (04)	10/04/04	2.5 - 3.5	<370	<370	<750	<750	<1500	<370	<15	<450	<600	<1500	<3700	<1500	<750	<370	<370
SB-10 (04)	10/04/04	4 - 5	<460	<460	<910	<910	<1800	<460	<18	<550	<730	<1800	<4600	<1800	<910	<460	<460
<p>NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. EB = Compound was detected in the associated equipment blank. J = estimated concentration. UJ = estimated reporting limit. R = result rejected upon validation.</p>																	

Table 5-3b

Concentrations of SVOCs Detected in Soil (ug/kg)
Former Residence, Garage, and Storage Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Anthracene	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(e) Pyrene	Benzo(ghi) perylene	Benzo(k) fluoranthene	Biphenyl	Bis(2-chloro ethoxy) methane	Bis(2-chloro isopropyl) ether	Bis(2-Ethylhexyl) phthalate	Butyl benzyl phthalate	Carbazole	Chrysene	Dibenzo(a,h) anthracene	Dibenzo furan	Diethyl phthalate
SO-01 (99)	08/04/99	0 - 0.5	35 J	160 J	180 J	250 J		250 J	80 J		<340	<340	450 EB	84 J	<340	180 J	<340	<340	<340
SO-02 (99)	08/04/99	0 - 0.5	<350	<350	<350	<350		<350	<350		<350	<350	66 J EB	<350	<350	<350	<350	<350	<350
SO-04 (99)	08/04/99	0 - 0.5	<360	46 J	42 J	66 J		42 J	<360		<360	<360	69 J EB	<360	<360	50 J	<360	<360	<360
SO-05 (99)	08/04/99	0 - 0.5	<350	100 J	110 J	230 J		130 J	<350		<350	<350	180 J EB	51 J	<350	120 J	<350	<350	<350
SO-06 (99)	08/04/99	0 - 0.5	70 J	520 J	290 J	580 J		270 J	120 J		<340	<340	410 EB	<340	<340	280 J	68 J	<340	<340
SO-07 (99)	08/04/99	0 - 0.5	210 J	530	510	560		280 J	120 J		490	340 J	1100 EB	660	<350	260 J	80 J	<350	560
SO-08 (99)	08/04/99	0 - 0.5	180 J	470	480	640		420	130 J		<340	<340	130 J EB	340	110 J	460	<340	44 J	<340
SO-09 (99)	08/04/99	0 - 0.5	93 J	810	990	1100		710	750 J		<350	<350	1300 EB	310 J	<350	830	940 J	<350	90 J
SO-10 (99)	08/04/99	0 - 0.5	200 J	570	540	670		460	160 J		54 J	<370 UJ	800 EB	160 J	86 J	520	120 J	49 J	510 J
WED-07 (99)	08/18/99	15 - 17	<420 UJ	<420 UJ	<420 UJ	<420 UJ		<420 UJ	<420 UJ		<420 UJ	<420 UJ	<420 UJ	<420 UJ	<420 UJ	<420 UJ	<420 UJ	<420 UJ	<420 UJ
SB-7 (04)	10/05/04	2 - 2	<360	<360	<360	<360	<360	<360	<360	<360	<360	<360	<720	<360	<360	<360	<360	<360	<360
SB-8 (04)	10/04/04	2 - 2.5	54000	45000	27000	19000	17000	11000	24000	4400	<4400	<4400	<8800	<4400	26000	43000	4500	24000	<4400
SB-9 (04)	10/04/04	2.5 - 3.5	<370	<370	<370	<370	<370	<370	<370	<370	<370	<370	<750	<370	<370	<370	<370	<370	<370
SB-10 (04)	10/04/04	4 - 5	<460	880	940	700	630	650	800	<460	<460	<460	<910	<460	<460	950	<460	<460	<460
<p>NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. EB = Compound was detected in the associated equipment blank. J = estimated concentration. UJ = estimated reporting limit. R = result rejected upon validation.</p>																			

Table 5-3b

Concentrations of SVOCs Detected in Soil (ug/kg)
Former Residence, Garage, and Storage Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Dimethyl phthalate	Di-n-butyl phthalate	Di-n-octyl phthalate	Fluor anthene	Fluorene	Hexachloro benzene	Hexachloro ethane	Indeno (1,2,3-cd) Pyrene	Isophorone	Naphthalene	Nitro benzene	P-Chloro-M-Cresol	Pentachloro phenol	Perylene	Phenanthrene	Phenol	Pyrene
SO-01 (99)	08/04/99	0 - 0.5	<340	37 J	<340	360	<340	<340	<340	200 J	<340	<340	<340	<340	<850		170 J	<340	300 J
SO-02 (99)	08/04/99	0 - 0.5	<350	<350	<350	<350	<350	<350	<350	<350	<350	<350	<350	<350	<870		<350	<350	<350
SO-04 (99)	08/04/99	0 - 0.5	<360	<360	<360	83 J	<360	<360	<360	<360	<360	<360	<360	<360	<900		50 J	<360	90 J
SO-05 (99)	08/04/99	0 - 0.5	<350	<350	<350	200 J	<350	<350	<350	110 J	<350	<350	<350	<350	<880		150 J	<350	230 J
SO-06 (99)	08/04/99	0 - 0.5	<340	<340	<340	960	<340	<340	<340	240 J	<340	<340	<340	<340	<850		310 J	<340	960
SO-07 (99)	08/04/99	0 - 0.5	460	430	430	660	<350	220 J	130 J	450	310 J	<350	260 J	370	180 J		250 J	240 J EB	750
SO-08 (99)	08/04/99	0 - 0.5	<340	<340	<340	1200	73 J	<340	<340	390	<340	39 J	<340	<340	<860		840	<340	1000
SO-09 (99)	08/04/99	0 - 0.5	66 J	74 J	560	1000	<350	<350	<350	940	44 J	220 J	<350	<350	<870		260 J	<350	1000
SO-10 (99)	08/04/99	0 - 0.5	51 J	83 J	99 J	1000	77 J	<370	<370	510	<370	59 J	<370	38 J	<930		810	48 J EB	1100
WED-07 (99)	08/18/99	15 - 17	<420 UJ	<420 UJ	<420 UJ	<420 UJ	<420 UJ	<420 UJ	<420 UJ	<420 UJ	<420 UJ	<420 UJ	<420 UJ	<420 UJ	<1000 UJ		<420 UJ	<420 UJ	<420 UJ
SB-7 (04)	10/05/04	2 - 2	<360	<360	<360	<360	<360	<360	<360	<360	<360	<360	<360	<360	<1400	<360	<360	<510	<360
SB-8 (04)	10/04/04	2 - 2.5	<4400	<4400	<4400	100000	37000	<4400	<4400	10000	<4400	19000	<4400	<4400	<18000	5100	160000	<6100	93000
SB-9 (04)	10/04/04	2.5 - 3.5	<370	<370	<370	690	<370	<370	<370	<370	<370	<370	<370	<370	<1500	<370	480	<520	570
SB-10 (04)	10/04/04	4 - 5	<460	<460	<460	2100	<460	<460	<460	620	<460	<460	<460	<460	<1800	<460	1400	<640	1800
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. EB = Compound was detected in the associated equipment blank. J = estimated concentration. UJ = estimated reporting limit. R = result rejected upon validation.																			

Table 5-3c

Concentrations of Metals Detected in Soil (mg/kg)
Former Residence, Garage, and Storage Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Aluminum, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Cyanide, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Silver, Total	Sodium, Total	Vanadium, Total	Zinc, Total
SO-01 (99)	08/04/99	0 - 0.5	3910 J	4.2 J	33.2 J	0.26 J	0.27 J	1120 J	27.3 J	3 J	88.3 J	1.6 J	16900 J	233 J	1500 J	143 J	<0.07 UJ	20.6 J	584 J	0.85 J	<253 UJ	16.5 J	199 J
SO-02 (99)	08/04/99	0 - 0.5	5690 J	<3.6 UJ	15.6 J	0.2 J	<0.1 UJ	318 J	7.5 J	2 J	6.7 J	1.1 J	6740 J	8 J	1060 J	70.5 J	<0.05 UJ	5.8 J	806 J	<0.29 UJ	<168 UJ	9.2 J	19.8 J
SO-04 (99)	08/04/99	0 - 0.5	7000 J	6.2 J	24.9 J	0.25 J	<0.11 UJ	374 J	13 J	2.7 J	33 J	0.26 J	7660 J	104 J	1400 J	117 J	<0.05 UJ	9.1 J	399 J	0.42 J	<244 UJ	10.9 J	61 J
SO-05 (99)	08/04/99	0 - 0.5	6660 J	9.4	57.2 J	0.34 J	0.63 J	2280 J	28.3 J	4.2 J	57.5 J	0.18 J	14700 J	113 J	2290 J	162 J	<0.06 UJ	17 J	832 J	0.7 J	<333 UJ	15.8 J	140 J
SO-06 (99)	08/04/99	0 - 0.5	5300 J	<3 UJ	32.7 J	0.21 J	<0.1 UJ	2190 J	14 J	3.4 J	65 J	0.26 J	10100 J	82.6 J	1920 J	130 J	<0.06 UJ	12.4 J	756 J	0.59 J	<717 UJ	12.9 J	138 J
SO-07 (99)	08/04/99	0 - 0.5	7500 J	9.3 J	60.5 J	0.31 J	0.61 J	2510 J	20.8 J	5.9 J	70.7 J	0.44 J	13600 J	151 J	2870 J	182 J	<0.13 UJ	23.2 J	1070 J	0.72 J	<623 UJ	18 J	379 J
SO-08 (99)	08/04/99	0 - 0.5	6850 J	5.1 J	33.6 J	0.3 J	<0.1 UJ	2250 J	16.5 J	4.3 J	43.9 J	0.17 J	10300 J	49 J	2740 J	173 J	<0.06 UJ	13.8 J	1030 J	0.51 J	<476 UJ	14.3 J	69.3 J
SO-09 (99)	08/04/99	0 - 0.5	6820 J	5.6 J	41.8 J	0.32 J	0.23 J	2940 J	17.5 J	4.5 J	66.9 J	0.28 J	11200 J	136 J	2220 J	168 J	<0.1 UJ	15 J	871 J	0.73 J	<471 UJ	16.9 J	171 J
SO-10 (99)	08/04/99	0 - 0.5	4780 J	4.9 J	36.3 J	0.28 J	0.32 J	1710 J	15.4 J	3.6 J	39.8 J	0.28 J	22000 J	94.4 J	1810 J	224 J	<0.13 UJ	11.6 J	736 J	1.1 J	<311 UJ	12.6 J	149 J
WED-07 (99)	08/18/99	15 - 17	3300	0.82	8.5	0.11 J	<0.12	782 J	7.8	1.9	4.9	<0.05 UJ	3890	3.4	1350 J	47.2	<0.06	7.9	623	<0.34	136	6.3	13.5
SB-7 (04)	10/05/04	0.5 - 1	7300	6.8	16	<0.22	<0.22	<710 U	14	3.3	18		9000	24	1800	100	0.26	11	<650 U	<0.45	<90	12	35
SB-8 (04)	10/04/04	3	7900	8.8	54	<0.22	0.91	8500	21	5.7	53		13000	180	3000	200	0.29	15	<1100 U	<0.45	<630 U	19	190
SB-9 (04)	10/04/04	2.5 - 3.5	4100	5.9	14	<0.22	<0.22	<760 U	19	2.5	29		12000	43	<1200 U	150	<0.08	13	<440 U	<0.44	<710 U	11	41
SB-10 (04)	10/04/04	1.5 - 2	8100	6.8	42	<0.24	0.43	<1900 U	17	4.4	52		10000	110	2400	120	0.13	15	<1500 U	<0.48	<150 U	17	140
NOTE: mg/kg = milligrams per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit. U = Laboratory result qualified as less than indicated limit based on blank contamination. R = result rejected upon validation.																							

Table 5-3d

Concentrations of PCBs and Pesticides Detected in Soil (ug/kg)
Former Residence, Garage, and Storage Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Aroclor 1248	Aroclor 1254	Aroclor 1260	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aldrin	alpha-Chlordane	Delta-BHC	Dieldrin	Endosulfan II	Endrin	Endrin aldehyde	Methoxychlor
SO-01 (99)	08/04/99	0 - 0.5	<34	<34	30 J	3.8 J	0.85 J	R	<1.8	R	<1.8	<3.4	<3.4	<3.4	0.92 J	<18
SO-02 (99)	08/04/99	0 - 0.5	<35	<35	<35	<3.5	0.48 J	<3.5	<1.8	<1.8	<1.8	<3.5	<3.5	<3.5	<3.5	<18
SO-04 (99)	08/04/99	0 - 0.5	60 J	<36	96	10	8.6	R	<1.8	<1.8	<1.8	<3.6	<3.6	<3.6	R	<18
SO-05 (99)	08/04/99	0 - 0.5	<35	<35	34 J	1.6 J	<3.5	R	<1.8	<1.8	<1.8	1.1 J	<3.5	<3.5	1 J	4.6 J
SO-06 (99)	08/04/99	0 - 0.5	110	<34	46	2.9 J	2.9 J	R	<1.8	<1.8	<1.8	2.4 J	<3.4	R	2.1 J	11 J
SO-07 (99)	08/04/99	0 - 0.5	<35	<35	12 J	<3.5	4.2	14 J	<1.8	<1.8	<1.8	1.2 J	<3.5	0.88 J	<3.5	<18
SO-08 (99)	08/04/99	0 - 0.5	19 J	<34	39 J	4.6 J	1.3 J	R	<1.8	R	<1.8	5.2 J	1.3 J	R	1.6 J	13 J
SO-09 (99)	08/04/99	0 - 0.5	75	<35	94	10 J	4.7 J	R	R	<1.8	1.4 J	5.6 J	<3.5	6.2 J	R	17 J
SO-10 (99)	08/04/99	0 - 0.5	33 J	<37	39 J	6.3	<3.7	R	0.41 J	2 J	<1.9	<3.7	<3.7	4.2 J	R	12 J
WED-07 (99)	08/18/99	15 - 17	<41	<41	<41	<4.1	<4.1	<4.1	<2.1	<2.1	<2.1	<4.1	<4.1	<4.1	<4.1	<21
SB-7 (04)	10/05/04	2 - 2.5	<36.2	<36.2	<36.2	<2.9	<2.9	<2.9	<1.45		<1.45	<2.9	<2.9	<2.9	<2.9	<14.5
SB-8 (04)	10/04/04	2 - 2.5	<438	<438	<438	1080	<702	<702	<351		<351	<702	<702	<702	<702	<3510
SB-9 (04)	10/04/04	2.5 - 3.5	<37.4	<37.4	<37.4	<30	<30	<30	<15		<15	<30	<30	<30	<30	<150
SB-10 (04)	10/04/04	4 - 5	<45.7	119	<45.7	<183	<183	<183	<91.3		<91.3	<183	<183	<183	<183	<913
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. R = result rejected upon validation.																

Table 5-3e

**Concentrations of Petroleum Hydrocarbons in Soil (ug/kg)
Former Residence Area, Garage, and Storage Area
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site**

Sample Location Identifier	Sample Date	Depth (ft)	C11-C22 Aromatic Hydrocarbons	C19-C36 Aliphatic Hydrocarbons	C9-C10 Aromatic Hydrocarbons
SO-01 (99)	08/04/99	0 - 0.5	13000	76000	<10000
SO-02 (99)	08/04/99	0 - 0.5	<8800	<4200	<9100
SO-04 (99)	08/04/99	0 - 0.5	<9000	64000	<9800
SO-05 (99)	08/04/99	0 - 0.5	130000	820000	<9500
SO-06 (99)	08/04/99	0 - 0.5	54000	100000	<9900
SO-07 (99)	08/04/99	0 - 0.5	47000	72000	<7600
SO-08 (99)	08/04/99	0 - 0.5	78000	210000	<9200
SO-09 (99)	08/04/99	0 - 0.5	60000	110000	12000
SO-10 (99)	08/04/99	0 - 0.5	26000	64000	<15000
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit.					

Table 5-4a

Concentrations of VOCs in Surface Water (ug/l)
Sutton Brook and Associated Tributaries and Wetland Areas
Remedial Investigation and Feasability Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	1,1,1-Trichloro ethane	1,1-Dichloro ethane	1,2,3-Trichloro benzene	1,2,4-Trimethyl benzene	1,3,5-Trimethyl benzene	1,3-Dichloro benzene	1,4-Dichloro benzene	1,4-Dioxane	2-Butanone	4-Methyl-2-pentanone	Acetone	Benzene	Chloro benzene	Chloro ethane	cis-1,2-Dichloro ethene
Sutton Brook																	
SW002 (95)	10/30/95	surface	3.5			1.1											
SW003 (95)	10/30/95	surface	0.88			<											
SW1-99	06/02/99	surface	<5	<5	<5	<5	<5	<1	<1					<5	<5	<5	<5
SW2-99	06/02/99	surface	<5	<5	<5	<5	<5	<1	<1					<5	<5	<5	<5
SW3-99	06/02/99	surface	<5	<5	<5	7.44	<5	<1	<1					<5	<5	<5	<5
SW4-99	06/03/99	surface	9.98	<5	<5	6.69	<5	<1	<1					<5	<5	<5	<5
SW-02 (99)	08/09/99	surface	<10	<10				<10	<10		<10 UJ	<10	<10 UJ	<10	<10	<10	
SW-03 (99)	08/09/99	surface	<10	<10				<10	<10		87 J	46	130 J	<10	<10	<10	
SW-05 (99)	08/10/99	surface	<10	<10				1 J	<10		79 J	54	160 J	3 J	3 J	<10	
SW-10 (99)	08/10/99	surface	<10	<10				<10	<10		<10 UJ	<10	<10 UJ	<10	<10	<10	
SW-31 (04)	10/22/04	0 - 0.5	<0.5	<0.75	<2.5	<2.5	<2.5	<2.5	<2.5	<5	<5	<5	<5	<0.5	<0.5	<1	<0.5
SW-32 (04)	10/22/04	0 - 0.5	<0.5	<0.75	<2.5	<2.5	<2.5	<2.5	<2.5	5.2	<5	<5	<5	<0.5	<0.5	<1	<0.5
SW-33	10/22/04	0 - 0.5	<0.5	<0.75	<2.5	1.4 J	0.39 J	<2.5	<2.5	5.4	1.9 J	1.4 J	2.3 J	<0.5	<0.5	<1	<0.5
	09/20/05		1.2	2.2	<2.5 UJ	14	3.4	<2.5	0.76 J	54	39	24	21	1.1	1.1	2.7	1.3
	02/16/06		<0.5	<0.75	<2.5	1.3 J	0.39 J	<2.5	<2.5	2.5 J	3.5 J	1 J	<14 U	<0.5	<0.5	<1	<0.5
	10/05/06		<0.5	0.29 J	<2.5	1.6 J	0.4 J	<2.5	<2.5	15	4.3 J	3 J	<14 U	0.3 J	0.38 J	0.63 J	<0.5
SW-34 (04)	10/22/04	0 - 0.5	2.2	1.7	<2.5	3	0.88 J	<2.5	<2.5	18	16	18	8.4	0.43 J	<0.5	1.9	0.89
SW-35 (04)	10/22/04	0 - 0.5	2	1.6	<2.5	2.9	0.84 J	<2.5	<2.5	13	14	15	8	0.4 J	<0.5	1.9	0.83
SW-36	10/21/04	0 - 0.5	1.2	0.97	<2.5	1.4 J	0.44 J	<2.5	<2.5	10	8	7.7	5	<0.5	<0.5	1.2	0.5
	09/20/05		0.37 J	1.1	<2.5 UJ	0.51 J	<2.5	<2.5	<2.5	39	<5	<5	4.2 J	<0.5	<0.5	1	<0.5
	02/16/06		<0.5	<0.75	<2.5	<2.5	<2.5	<2.5	<2.5	3.3 J	2.5 J	1.9 J	<5 U	<0.5	<0.5	<1	<0.5
	10/05/06		0.4 J	0.77	<2.5	2 J	0.68 J	<2.5	0.29 J	23	4.2 J	2.2 J	<9.4 U	<0.5	<0.5	1.5	0.34 J
SW-37	10/21/04	0 - 0.5	0.7	0.62 J	<2.5	0.66 J	<2.5	<2.5	<2.5	7	3.6 J	2.6 J	3.7 J	<0.5	<0.5	0.65 J	<0.5
	09/20/05		<0.5	0.43 J	<2.5 UJ	<2.5	<2.5	<2.5	<2.5	53	<5	<5	<5	<0.5	<0.5	0.48 J	<0.5
	02/16/06		<0.5	<0.75	<2.5	<2.5	<2.5	<2.5	<2.5	5	3 J	1.9 J	<5 U	<0.5	<0.5	<1	<0.5
	10/05/06		<0.5	0.46 J	<2.5	0.45 J	<2.5	<2.5	<2.5	20	<5	0.49 J	<5 U	<0.5	<0.5	0.77 J	<0.5
SW-214 (06)	11/09/06	0 - 0.5	<0.5	<0.75	0.41 J	<2.5	<2.5	<2.5	<2.5	<5	<5	<5	R	<0.5	<0.5	<1	<0.5
SW-215 (06)	11/10/06	0 - 0.5	<0.5	<0.75	<2.5	<2.5	<2.5	<2.5	<2.5	<5	<5	<5	R	<0.5	<0.5	<1	<0.5
Associated Tributaries																	
SW-08 (99)	08/09/99	surface	6 J	5 J				<12	<12		180 J	120	180 J	3 J	<10	<10	
SW-09 (99)	08/10/99	surface	<10	<10				<10	<10		<10 UJ	<10	22 J	<10	<10	<10	
SW-38 (04)	10/21/04	0 - 0.5	<0.5	<0.75	<2.5	<2.5	<2.5	<2.5	<2.5	<5	<5	<5	<5	<0.5	<0.5	<1	<0.5
SW-43 (04)	10/22/04	0 - 0.5	<0.5	<0.75	<2.5	<2.5	<2.5	<2.5	<2.5	1.4 J	<5	<5	2.9 J	<0.5	<0.5	<1	<0.5
Associated Wetlands																	
SW-106 (05)	12/02/05	0 - 0.5	0.52	0.48 J	<2.5	0.55 J	<2.5	<2.5	<2.5	7.3	6.3	3.8 J	6.9	<0.5	<0.5	<1	<0.5
SW-107 (05)	12/02/05	0 - 0.5	<0.5	<0.75	<2.5	<2.5	<2.5	<2.5	<2.5	3.8 J	<5	<5	<5	<0.5	<0.5	<1	<0.5
SW-108 (05)	12/01/05	0 - 0.5	<0.5	<0.75	<2.5	<2.5	<2.5	<2.5	<2.5	1.4 J	<5	<5	2.7 J	<0.5	<0.5	<1	<0.5
SW-109 (05)	12/01/05	0 - 0.5	<0.5	<0.75	<2.5	<2.5	<2.5	<2.5	<2.5	1.4 J	<5	<5	2.9 J	<0.5	<0.5	<1	<0.5
SW-110 (05)	12/02/05	0 - 0.5	<0.5	<0.75	<2.5	<2.5	<2.5	<2.5	0.62 J	110	<5	<5	7.2	1.4	1.9	<1	<0.5
NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. R = result rejected upon data validation. J = estimated concentration. UJ = estimated reporting limit. U = laboratory result qualified as estimated due to blank contamination																	

Table 5-4a

Concentrations of VOCs in Surface Water (ug/l)
Sutton Brook and Associated Tributaries and Wetland Areas
Remedial Investigation and Feasability Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Ethyl Ether	Ethyl benzene	Isopropyl benzene	Methyl tert butyl ether	Methylene chloride	n-Propyl benzene	o-Xylene	p/m-Xylene	Tetra hydrofuran	Toluene	Trichloro fluoro methane	Vinyl acetate	Vinyl chloride	Xylenes (total)
Sutton Brook																
SW002 (95)	10/30/95	surface		1.5								15				3.5
SW003 (95)	10/30/95	surface		<								0.85				<
SW1-99	06/02/99	surface		<5	<5		<10	<5				5.34	<5		<2	7.22
SW2-99	06/02/99	surface		<5	<5		<10	<5				8.35	<5		<2	5.95
SW3-99	06/02/99	surface		7.94	<5		10.7	<5				46.5	<5		<2	30.9
SW4-99	06/03/99	surface		12	<5	<5	13.4	<5	13.6	36.5		123	<5		<2	33.4
SW-02 (99)	08/09/99	surface		<10			<10					<10			<10	<10
SW-03 (99)	08/09/99	surface		<10			<10					14			<10	10 J
SW-05 (99)	08/10/99	surface		12			<10					78			<10	37
SW-10 (99)	08/10/99	surface		<10			<10					<10			<10	<10
SW-31 (04)	10/22/04	0 - 0.5	<2.5	<0.5	<0.5	<1	<5	<0.5	<0.5	<0.5	<10	0.32 J	<2.5	<5	<1	
SW-32 (04)	10/22/04	0 - 0.5	<2.5	<0.5	<0.5	<1	<5	<0.5	<0.5	<0.5	3.1 J	<0.75	<2.5	<5	<1	
SW-33	10/22/04	0 - 0.5	0.45 J	1	0.32 J	<1	<5	0.34 J	0.63	3.5	14	8.2	<2.5	<5	<1	
	09/20/05		1.9	8.8	2	<1	2.3 J	2.2	8.9	28	61	97	0.66 J	<5 UJ	0.44 J	
	02/16/06		<2.5	0.53	<0.5	<1	<5	<0.5	<0.5	2.4	<10 U	5.1	<2.5	<5	<1	
	10/05/06		0.68 J	1	0.48 J	<1	<5 U	0.36 J	0.66	3.7	18	10	<2.5	<5	<1	
SW-34 (04)	10/22/04	0 - 0.5	0.77 J	3.5	0.42 J	<1	3.1 J	0.5	2.9	12	40	47	0.36 J	1.6 J	<1	
SW-35 (04)	10/22/04	0 - 0.5	0.8 J	2.9	0.44 J	<1	2.9 J	0.47 J	2.6	12	40	38	<2.5	1.6 J	<1	
SW-36	10/21/04	0 - 0.5	0.57 J	1.5	<0.5	0.46 J	1.7 J	<0.5	1.3	6.3	23	20	<2.5	<5	<1	
	09/20/05		0.49 J	<0.5	<0.5	<1	1.3 J	<0.5	0.65	1.6	32	<0.75 U	<2.5	<5 UJ	<1	
	02/16/06		<2.5	0.31 J	<0.5	<1	<5	<0.5	<0.5	1	<10 U	4.6	<2.5	<5	<1	
	10/05/06		0.96 J	0.78	0.4 J	<1	<5 U	<0.5	1.2	5	30	5.2	<2.5	<5	<1	
SW-37	10/21/04	0 - 0.5	0.36 J	0.54	<0.5	0.67 J	1 J	<0.5	0.54	2.5	16 J	5 J	<2.5	<5 UJ	<1 UJ	
	09/20/05		<2.5	<0.5	<0.5	<1	0.51 J	<0.5	<0.5	<0.5	19	<0.75 U	<2.5	<5 UJ	<1	
	02/16/06		<2.5	<0.5	<0.5	<1	<5	<0.5	<0.5	0.93	<10 U	3.3	<2.5	<5	<1	
	10/05/06		0.66 J	<0.5	<0.5	0.16 J	<5	<0.5	<0.5	1.2	22	<0.75	<2.5	<5	<1	
SW-214 (06)	11/09/06	0 - 0.5	<2.5	<0.5	<0.5	<1	<5	<0.5	<0.5	<0.5	<10	<0.75	<2.5	<5 UJ	<1	
SW-215 (06)	11/10/06	0 - 0.5	<2.5	<0.5	<0.5	<1	<5	<0.5	<0.5	<0.5	<10	<0.75	<2.5	<5 UJ	<1	
Associated Tributaries																
SW-08 (99)	08/09/99	surface		<10			<10					72			<10	33
SW-09 (99)	08/10/99	surface		<10			<10					<10			<10	<10
SW-38 (04)	10/21/04	0 - 0.5	<2.5	<0.5	<0.5	2.6	<5	<0.5	<0.5	<0.5	<10	<0.75	<2.5	<5	<1	
SW-43 (04)	10/22/04	0 - 0.5	<2.5	<0.5	<0.5	<1	<5	<0.5	<0.5	<0.5	2.5 J	<0.75	<2.5	<5 UJ	<1	
Associated Wetlands																
SW-106 (05)	12/02/05	0 - 0.5	<2.5	0.61	<0.5	<1	<5	<0.5	0.51	1.9	9.5 J	8.2	<2.5	<5 UJ	<1	
SW-107 (05)	12/02/05	0 - 0.5	<2.5	<0.5	<0.5	<1	<5	<0.5	<0.5	<0.5	2.6 J	<0.75	<2.5	<5 UJ	<1	
SW-108 (05)	12/01/05	0 - 0.5	<2.5	<0.5	<0.5	<1	<5	<0.5	<0.5	<0.5	1.5 J	3.1	<2.5	<5 UJ	<1	
SW-109 (05)	12/01/05	0 - 0.5	<2.5	<0.5	<0.5	<1	<5	<0.5	<0.5	<0.5	2.5 J	<0.75	<2.5	<5 UJ	<1	
SW-110 (05)	12/02/05	0 - 0.5	3	<0.5	0.66	<1	<5	<0.5	<0.5	<0.5	58	<0.75	<2.5	<5 UJ	<1	
NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. R = result rejected upon data validation. J = estimated concentration. UJ = estimated reporting limit. U = laboratory result qualified as estimated due to blank contamination																

Table 5-4b
Concentrations of SVOCs in Surface water (ug/l)
Sutton Brook and Associated Tributaries and Wetland Areas
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	2,4-Dimethyl phenol	2-Methyl phenol	3-Methylphenol/ 4-Methylphenol	4-Methyl phenol	Bis(2-Ethylhexyl) phthalate	Naphthalene	Phenol
Sutton Brook									
SW002 (95)	06/27/95	surface						1.8	46
SW003 (95)	06/27/95	surface						<	1.1 J
SW1-99	06/02/99	surface	<3.75	<1	<1.5		<2	<0.75	<0.25
SW2-99	06/02/99	surface	<3.75	<1	<1.5		<2	<0.75	<0.25
SW3-99	06/02/99	surface	<3.75	<1	<1.5		<2	0.971	<0.25
SW4-99	06/03/99	surface	<3.75	2.73	11.7		<2	0.8	20.2
SW-02 (99)	08/09/99	surface	<10	<10		<10	1 J	<10	<10
SW-03 (99)	08/09/99	surface	<10	<10		<10	<10	<10	<10
SW-05 (99)	08/10/99	surface	1 J	3 J		15	1 J	2 J	<12
SW-10 (99)	08/10/99	surface	<10	<10		2 J	<10	<10	<10
SW-31 (04)	10/22/04	0 - 0.5	<9.7	<5.8	<5.8		<4.8	<2.5 UJ	<6.8
SW-32 (04)	10/22/04	0 - 0.5	<10	<6	<6		<5	<2.5 UJ	<7
SW-33	10/22/04	0 - 0.5	<10	<6	<6		<5	1.7 J	<7
	09/20/05							<2.5 UJ	
	02/16/06							<2.5	
	10/05/06							<2.5	
SW-34 (04)	10/22/04	0 - 0.5	<10	<6	<6		<5	1.7 J	<7
SW-35 (04)	10/22/04	0 - 0.5	<10	<6	<6		<5	1.7 J	<7
SW-36	10/21/04	0 - 0.5	<9.7	<5.8	<5.8		<4.8	<2.5 UJ	<6.8
	09/20/05							<2.5 UJ	
	02/16/06							<2.5	
	10/05/06							<2.5	
SW-37	10/21/04	0 - 0.5	<9.7	<5.8	<5.8		<4.8	<2.5 UJ	<6.8
	09/20/05							<2.5 UJ	
	02/16/06							<2.5	
	10/05/06							<2.5	
SW-214 (06)	11/09/06	0 - 0.5						0.47 J	
SW-215 (06)	11/10/06	0 - 0.5						<2.5 UJ	
Associated Tributaries									
SW-08 (99)	08/09/99	surface	<12	<12		<12	<12	<12	<12
SW-09 (99)	08/10/99	surface	<10	<10		<10	<10	<10	<10
SW-38 (04)	10/21/04	0 - 0.5	<10	<6	<6		<5	<2.5 UJ	<7
SW-43 (04)	10/22/04	0 - 0.5	<10	<6	<6		<5	<2.5 UJ	<7
Associated Wetlands									
SW-106 (05)	12/02/05	0 - 0.5						<2.5	
SW-107 (05)	12/02/05	0 - 0.5						<2.5	
SW-108 (05)	12/01/05	0 - 0.5						<2.5	
SW-109 (05)	12/01/05	0 - 0.5						<2.5	
SW-110 (05)	12/02/05	0 - 0.5						2.6	
NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit.									

Table 5-4c

Concentrations of Metals in Surface Water (mg/l)
Sutton Brook and Associated Tributaries and Wetland Areas
Remedial Investigation and Feasability Study
Sutton Brook Disposal Area Superfund Site

Sample Location	Sample Date	Screened Interval (ft)	Aluminum		Arsenic		Barium		Beryllium		Cadmium		Calcium		Chromium		Cobalt		Copper		Cyanide	Iron	
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total	Dissolved
Sutton Brook																							
SW001 (95)	06/27/95	surface			0.002		0.02				<0.01				<0.01				<0.01		0.017	9.4	
SW002 (95)	06/27/95	surface			0.049		0.1				<0.01				<0.01				<0.01		<0.01	9.4	
SW003 (95)	06/27/95	surface			0.068		0.05				<0.01				<0.01				<0.01		0.0188	10	
SW1-99	06/02/99	surface			<0.05				<0.003		<0.005				<0.06				<0.008				
SW2-99	06/02/99	surface			0.043				<0.002		0.03				<0.06				<0.008				
SW3-99	06/02/99	surface			<0.05				<0.003		<0.005				<0.06				<0.008				
SW4-99	06/03/99	surface			0.031				<0.002		0.02				<0.06				<0.008				
SW-02 (99)	08/09/99	surface	<0.029		0.0338		0.0909		<0.001		<0.001		66.7		0.0015 J		0.0032		<0.001		<0.002	2.9	
SW-03 (99)	08/09/99	surface	0.286		0.131		0.138		<0.001		<0.001		68.5		0.0021		0.0037		0.0034		<0.002	13.7	
SW-05 (99)	08/10/99	surface	0.369		0.147		0.194		<0.001		<0.001		65.6		0.0023		0.0052		0.0023		<0.002	28.1	
SW-10 (99)	08/10/99	surface	3.17		0.0095		0.0568		<0.001		<0.001		42.7		0.0047		0.0055		0.0163		<0.002	9.58	
SW-31 (04)	10/22/04	0 - 0.5	<0.088 U	<0.11 U	<0.005	<0.005	0.02	0.02	<0.002	<0.0004U	<0.002	<0.002	14	15	<0.01	<0.01	<0.01	<0.01	<0.01	0.003 J		1.5	0.64
SW-32 (04)	10/22/04	0 - 0.5	0.34	<0.18 U	0.013	0.012	0.02	0.02	<0.0004 U	<0.002	<0.002	<0.002	14	15	<0.01	<0.01	0.001 J	0.001 J	<0.01	0.003 J		2.3	1.4
SW-33	10/22/04	0 - 0.5	0.36		0.014		0.028		<0.0005 U	<0.002	<0.002		15		<0.01		0.001 J		<0.01			3.1	
	09/20/05		<0.66 U	<0.1	0.058	0.014	0.09	0.08	0.0005 J	<0.002	<0.002	<0.002	39	37	<0.01	<0.01	<0.003 U	<0.002 U	<0.01	<0.01		8.9	0.12
	02/16/06		0.72	<0.12 U	0.0044 J	0.0042 J	0.03	0.02	<0.002	<0.002	<0.002	<0.0011 U	16	15	0.002 J	0.002 J	<0.002	0.001 J	<0.01	<0.01		1.4 J	0.75
	10/05/06		0.026 J	<0.1	0.024	0.01	0.05	0.04	<0.002	<0.002	<0.002	<0.002	23	21	<0.01	0.001 J	0.001 J	0.001 J	<0.01	<0.01		4.7	0.76
SW-34 (04)	10/22/04	0 - 0.5	0.36		0.029		0.03		<0.002		<0.002		18		<0.01		0.001 J		<0.01			5.4	
SW-35 (04)	10/22/04	0 - 0.5	0.36	<0.19 U	0.028	0.0206	0.03	0.03	<0.002		<0.002		18	18	<0.01	<0.01	0.001 J	0.001 J	<0.01	0.003 J		6.1	3.6
SW-36	10/21/04	0 - 0.5	0.38	<0.16 U	0.018	0.0127	0.027	0.02	<0.002	<0.002	<0.002	<0.002	16	15	<0.01	<0.01	0.002 J	0.001 J	<0.01	<0.01		4.4	2.6
	09/20/05		<0.09 U	<0.056 U	0.021	0.007	0.06	0.05	0.0005 J	<0.002	<0.002	<0.002	31	30	0.002 J	0.002 J	<0.002 U	<0.002 U	<0.01	<0.01		3.7	0.51
	02/16/06		0.14	<0.11 U	<0.005	<0.005	0.02	0.02	<0.002	<0.002	<0.002	<0.0008 U	14	15	<0.01	<0.01	<0.002 U	0.001 J	<0.01	<0.01		0.76 J	0.55
	10/05/06		0.029 J	<0.022 U	0.019	0.009	0.04	0.04	<0.002	<0.002	<0.002	<0.002	24	22	<0.01	0.002 J	0.002 J	0.002 J	<0.01	<0.01		4.2	1.2
SW-37	10/21/04	0 - 0.5	<0.25 U		0.014		0.02		<0.002	<0.002	<0.002		16		<0.01		0.002 J		<0.01			3.2	
	09/20/05		<0.085 U	<0.049 U	0.018	0.009	0.05	0.04	0.0004 J	<0.002	<0.002	<0.002	34	33	<0.01	<0.01	<0.002 U	<0.002 U	<0.01	<0.01		2.6	0.76
	02/16/06		0.14	<0.088 U	<0.005	<0.005	0.02	0.02	<0.002	<0.002	<0.002	<0.002	17	16	<0.01	<0.01	<0.002 U	<0.002 U	<0.01	<0.01		0.96 J	0.5
	10/05/06		0.04 J	<0.022 U	0.016	0.007	0.04	0.03	<0.002	<0.002	<0.002	<0.002	23	22	<0.01	0.001 J	0.002 J	0.002 J	<0.01	<0.01		3.1	1.2
SW-214 (06)	12/01/05	0 - 0.5		0.1		<0.005		0.0097 J		<0.002		<0.002		5.6		<0.01		<0.01		<0.01		0.21	
SW-215 (06)	12/01/05	0 - 0.5		0.072 J		<0.005		0.015		<0.002		<0.002		9.9		<0.01		0.0007 J		<0.01		0.26	
Associated Tributaries																							
SW-08 (99)	08/09/99	surface	1.11		0.0777		0.143		<0.001		<0.001		67.9		0.0038		0.0047		0.0077		<0.002	10.3	
SW-09 (99)	08/10/99	surface	<0.109		0.0081		0.0459		<0.001		<0.001		47.1		<0.001		<0.001		0.0047		<0.002	8.4	
SW-38 (04)	10/21/04	0 - 0.5	<0.1 U		0.028		0.039		<0.002		<0.002		30		<0.01		0.001 J		<0.01			2	
SW-43 (04)	10/22/04	0 - 0.5	1		<0.005		0.01		<0.002		<0.002		9		<0.01		0.002 J		<0.01			1.6	
Associated Wetlands																							
SW-106 (05)	12/02/05	0 - 0.5	1.8	<0.14 U	0.03	0.009	0.04	0.02	<0.002	<0.002	<0.002	<0.002	16	13	0.003 J	<0.01	0.002 J	0.001 J	0.008 J	<0.01		6.5	1.7
SW-107 (05)	12/02/05	0 - 0.5	0.64	<0.13 U	0.011	0.007	0.03	0.02	<0.002	<0.002	<0.002	<0.002	16	14	0.001 J	<0.01	0.001 J	<0.01	0.006 J	<0.01		3	1.1
SW-108 (05)	12/01/05	0 - 0.5	2.6	0.22	0.011	0.0047 J	0.04	0.01	<0.002	<0.002	<0.002	<0.002	11	8.8	0.004 J	<0.01	0.002 J	0.001 J	0.01 J	<0.01		3.1	0.6
SW-109 (05)	12/01/05	0 - 0.5	2.3	<0.081 U	0.042	<0.005	0.1	0.01	0.0008 J	<0.002	<0.002 UJ	<0.002	19	8.7	0.002 J	<0.01	0.004 J	<0.01	0.02	<0.01		110	1.1
SW-110 (05)	12/02/05	0 - 0.5	<0.06 U	<0.047 U	0.025	0.006	0.17	0.14	<0.002	<0.002	<0.002	<0.002	110	110	0.004 J	0.004 J	0.004 J	0.004 J	0.003 J	0.003 J		7.1	0.12
NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. R = Result rejected upon validation. J = estimated concentration. U = laboratory result qualified as estimated due to blank contamination. UJ = estimated reporting limit.																							

Table 5-4c

Concentrations of Metals in Surface Water (mg/l)
Sutton Brook and Associated Tributaries and Wetland Areas
Remedial Investigation and Feasability Study
Sutton Brook Disposal Area Superfund Site

Sample Location	Sample Date	Screened Interval (ft)	Lead		Magnesium		Manganese		Mercury		Nickel		Potassium		Selenium		Sodium		Thallium		Vanadium		Zinc	
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sutton Brook																								
SW001 (95)	06/27/95	surface	<0.05				0.66		<0.0002						<0.002								0.03	
SW002 (95)	06/27/95	surface	<0.05				0.66		<0.0002						<0.002								<0.01	
SW003 (95)	06/27/95	surface	<0.05				0.89		<0.0002						<0.002								0.01	
SW1-99	06/02/99	surface	<0.02						<0.0005		0.02				<0.05				<0.2				0.05	
SW2-99	06/02/99	surface	0.005						<0.0005		<0.01				0.001				<0.001				<0.01	
SW3-99	06/02/99	surface	<0.02						<0.0005		0.03				<0.05				<0.2				0.08	
SW4-99	06/03/99	surface	0.008						<0.0005		0.02				0.002				0.002				0.23	
SW-02 (99)	08/09/99	surface	<0.0012 UJ		25.9		0.981		0.0001 J		0.0112		56		<0.004 UJ		121		<0.003		<0.001		0.0239	
SW-03 (99)	08/09/99	surface	<0.0021		25.7		1.26		0.00014 J		0.0109		55.7		<0.004 UJ		119		<0.003		0.0021		0.0196	
SW-05 (99)	08/10/99	surface	<0.0051		25		1.48		0.00019 J		0.0117		54.5		<0.004 UJ		111		<0.003		0.003		0.0313	
SW-10 (99)	08/10/99	surface	0.0321		7.37		0.767		0.00012 J		0.0078		10.1		<0.004 UJ		17.5		<0.003		0.0059		9.44	
SW-31 (04)	10/22/04	0 - 0.5	<0.01	<0.01	3.6	3.8	0.18	0.16	<0.0002	<0.0002	0.0015 J	0.0017 J	3.3 J	3.4 J	<0.005	<0.005	61	66	<0.005	<0.005	<0.01	<0.01	0.012 J	0.015 J
SW-32 (04)	10/22/04	0 - 0.5	<0.01	<0.01	4.1	4.1	0.28	0.27	<0.0002	<0.0002	0.0021 J	0.0025 J	8.3 J	8.1 J	<0.005	<0.005	48	53	<0.005	<0.005	<0.01	<0.01	0.01 J	0.015 J
SW-33	10/22/04	0 - 0.5	<0.01		4.4		0.29		<0.0002		0.0027 J		9.1 J		<0.005		48		<0.005		<0.01		0.012 J	
	09/20/05		<0.01	<0.01	12	11	0.58	0.53	<0.0002	<0.0002	0.0064 J	<0.0065 U	24	22	<0.005	<0.005	76	70	<0.005	<0.005	<0.001 U	<0.001 U	0.013 J	0.032
	02/16/06		<0.01	<0.01	4.3	4.2	0.21	0.19	<0.0002	<0.0002	0.0043 J	0.0027 J	8.9	7.3	<0.005	<0.005	60	56	<0.005	<0.005	<0.002 U	<0.01	0.032 J	0.039
	10/05/06		<0.01	<0.01	6.2	5.7	0.32	0.29	<0.0002	<0.0002	0.003 J	0.0027 J	12	11	<0.005	<0.005	78	71	<0.005	<0.005	<0.01	<0.01	0.027 J	<0.023
SW-34 (04)	10/22/04	0 - 0.5	<0.01		5.6		0.36		<0.0002		0.0028 J		13 J		<0.005		54		<0.005		0.001 J		0.011 J	
SW-35 (04)	10/22/04	0 - 0.5	<0.01	<0.01	5.5	5.4	0.39	0.37	<0.0002	<0.0002	0.0031 J	0.0034 J	12 J	11 J	<0.005	<0.005	51	54	<0.005	<0.005	0.001 J	0.001 J	0.011 J	0.014 J
SW-36	10/21/04	0 - 0.5	<0.01	<0.01	4.7	4.4	0.29	0.27	<0.0002	0.00003 J	0.0029 J	0.0071 J	9.5 J	8.8 J	<0.005		46	46	<0.005	<0.005	0.001 J	<0.01	0.009 J	0.013 J
	09/20/05		<0.01	<0.01	9.6	9.2	0.44	0.39	<0.0002	<0.0002	0.0046 J	<0.0044 U	20	18	<0.005	<0.005	62	59	<0.005	<0.005	<0.001 U	<0.001 U	0.01 J	0.038 J
	02/16/06		<0.01	<0.01	3.8	4	0.12	0.12	<0.0002	<0.0002	0.0029 J	0.0026 J	5.4	4.6	<0.005	<0.005	52	50	<0.005	<0.005	<0.001 U	<0.01 U	0.014 J	0.022 J
	10/05/06		<0.01	<0.01	7.3	6.8	0.4	0.37	<0.0002	<0.0002	0.0034 J	0.0039 J	14	13	<0.005	<0.005	68	63	<0.005	<0.005	<0.01	0.001 J	0.01 J	<0.017 U
SW-37	10/21/04	0 - 0.5	<0.01		4.6		0.37		<0.0002		0.0028 J		9.2 J		<0.005		45		<0.005		0.001 J		0.007 J	
	09/20/05		<0.01	<0.01	10	10	0.83	0.76	<0.0002	<0.0002	0.0045 J	<0.0042 U	20	19	<0.005	<0.005	65	62	<0.005	<0.005	<0.001 U	<0.001 U	<0.05	0.024 J
	02/16/06		<0.01	<0.01	4.5	4.4	0.25	0.24	<0.0002	<0.0002	0.0033 J	0.0018 J	7	6.5	<0.005	<0.005	56	52	<0.005	<0.005	<0.001 U	<0.01	<0.05	0.026 J
	10/05/06		<0.01	<0.01	6.7	6.3	0.49	0.45	<0.0002	<0.0002	0.0021 J	0.0033 J	13	12	<0.005	<0.005	62	58	<0.005	<0.005	<0.01	<0.01	0.018 J	<0.012 U
SW-214 (06)	12/01/05	0 - 0.5		<0.01		1.3		0.03		<0.0002		<0.025		1.7 J		<0.005		18		<0.005		<0.01	0.006 J	0.02 J
SW-215 (06)	12/01/05	0 - 0.5		<0.01		2.4		0.063		<0.0002		0.002 J		2.4 J		<0.005		40		<0.005		<0.01		0.024 J
Associated Tributaries															<0.005									
SW-08 (99)	08/09/99	surface	0.0124		26.1		1.13		0.00011 J		0.0134		55.9		<0.004 UJ		118		<0.003		0.0042		0.0708	
SW-09 (99)	08/10/99	surface	<0.002 UJ		9.35		0.75		<0.0001		0.0028		5.55		<0.004 UJ		24.4		<0.003		<0.001		0.0292	
SW-38 (04)	10/21/04	0 - 0.5	<0.01		6.9		0.95		<0.0002		0.002 J		17 J		<0.005		49		<0.005		<0.01		0.006 J	
SW-43 (04)	10/22/04	0 - 0.5	<0.01		2.8		0.42		<0.0002		0.0027 J		10 J		<0.005		16		<0.005		0.002 J		0.009 J	
Associated Wetlands																								
SW-106 (05)	12/02/05	0 - 0.5	0.019	<0.01	4.4	3.7	0.33	0.38	<0.0002	<0.0002	0.0049 J	0.0027 J	8.3	7.5	<0.005		46	42	<0.005		0.004 J	0.001 J	0.15	<0.07 U
SW-107 (05)	12/02/05	0 - 0.5	0.013	<0.01	4.2	3.8	0.2	0.15	<0.0002	<0.0002	0.0041 J	0.0023 J	8	7.1	<0.005		43	39	<0.005		0.002 J	0.001 J	0.11	<0.07 U
SW-108 (05)	12/01/05	0 - 0.5	0.022	0.005 J	2.9	2.4	0.22	0.16	0.00003 J	<0.0002	0.005 J	0.0027 J	6.8	5.9	<0.005		32	29	<0.005		0.005 J	0.001 J	0.14	<0.1 U
SW-109 (05)	12/01/05	0 - 0.5	0.05	<0.01	3.2	2.1	0.53	0.11	0.00013 J	<0.0002	0.008 J	0.0016 J	8.8	7.3	0.0042 J		11	10	<0.005		0.02	<0.01	0.17	<0.12 U
SW-110 (05)	12/02/05	0 - 0.5	0.005 J	<0.01	50	48	1.1	0.98	<0.0002	0.00006 J	0.0091 J	0.0088 J	100	100	<0.005		200	190	<0.005		0.001 J	0.001 J	0.07	<0.06 U
NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. R = Result rejected upon validation. J = estimated concentration. U = laboratory result qualified as estimated due to blank contamination. UJ = estimated reporting limit.																								

Table 5-4d

Concentrations of VOCs in Sediment (ug/kg)
Sutton Brook and Associated Tributaries and Wetland Areas
Remedial Investigation and Feasability Study
Sutton Brook Disposal Area Superfund Site

Sample Location	Sample Date	Depth (ft)	1,2,4- Trimethyl benzene	1,2- Dichloro benzene	1,3,5- Trimethyl benzene	1,4- Dichloro benzene	2-Butanone	4-Methyl-2- pentanone	Acetone	Benzene	Carbon disulfide	Chloro benzene	Chloro ethane	cis-1,2- Dichloro ethene	Ethyl Ether
Sutton Brook															
SD-01 (89)	10/26/89	0 - 0		<430		<430	<21	<21	<10	<10	<10	<10	<21		
SD-03 (89)	10/26/89	0 - 0		<400		<400	<20 UJ	<20	<20 UJ	<10	<10 UJ	<10	<20 UJ		
SD001 (95)	10/30/95	0 - 0.5													
SD003 (95)	10/30/95	0 - 0.5													
SD-20 (99)	08/10/99	0 - 0.5	<7 UJ	<430	<7 UJ	<430	<7	<7	0 R	<7	<7 UJ	<7	<7	<7	
SD-21 (99)	08/10/99	0 - 0.5	640	<350	130 J	<350	230	100	56 J	10 J	6 J	3 J	5 J	<4 UJ	
SD-22 (99)	08/09/99	0 - 0.5	3000	<570	180 J	<570	45 J	34	38 J EB	15	15	28	35	<8	
SD-23 (99)	08/09/99	0 - 0.5	94 J	<890	16000	<890	88 J	<20	270 J EB	63	<20	<220 UJ	85	28	
SD-24 (99)	08/09/99	0 - 0.5	R	<660	R	<660	53 J	R	320 J EB	R	R	R	R	R	
SD-25 (99)	08/09/99	0 - 0.5	<10 UJ	<670	<10 UJ	<670	37	<10	220 J EB	<10	<10 UJ	<10	<10	<10	
SD-26 (99)	08/09/99	0 - 0.5	<6	<460	<6	<460	<6	<6	18 J EB	<6	<6	<6	<6	<6	
SD-31 (04)	10/22/04	0 - 0.5	<250	<250	<250	<250	<500	<500	<500	<50	<500	<50	<100	<50	<250
SD-32 (04)	10/22/04	0 - 0.5	<560	<560	<560	<560	<1100	<1100	<1100	<110	<1100	120	<220	<110	<560
SD-33 (04)	10/22/04	0 - 0.5	1300 J	<180	460 J	<180	<360	<360	<360	<36	<360	<36	<72 UJ	1700 J	<180
SD-34 (04)	10/22/04	0 - 0.5	<300	<300	<300	<300	<600	<600	<600	<60	<600	<60	<120	<60	<300
SD-35 (04)	10/22/04	0 - 0.5	<230	<230	<230	<230	<450	<450	<450	<45	<450	<45	<91	<45	<230
SD-36 (04)	10/21/04	0 - 0.5	<330	<330	<330	<330	<660	<660	<660 UJ	<66	<660	<66	<130	<66	<330
SD-37 (04)	10/21/04	0 - 0.5	<240	<240	<240	<240	<490	<490	<490 UJ	<49	<490	<49	<98	<49	<240
SD-214 (06)	11/09/06	0 - 0.5	<4.4	<4.4	<4.4	<4.4	7.6 J	<8.9	58	<0.89	6.7 J	<0.89	<1.8	<0.89	<4.4
SD-215 (06)	11/09/06	0 - 1	<5 UJ	<5 UJ	<5 UJ	<5 UJ	8.6 J	<10	63 J	<1	<10	<1	<2	<1	<5
Associated Tributaries															
SD-14 (99)	08/10/99	0 - 0.5	R	<660	R	<660	450 J	R	720 J	R	R	R	R	R	
SD-16 (99)	08/09/99	0 - 0.5	<12 UJ	<590	<12 UJ	<590	R	<12	93 J EB	<12	<12	<12 UJ	<12	<12	
SD-38 (04)	11/18/04	0 - 2	R	R	R	R	64 J	R	260 J	R	R	R	R	R	R
SD-43 (04)	10/22/04	0 - 0.5	<300	<300	<300	<300	<600	<600	<600	<60	<600	<60	<120	<60	<300
Associated Wetlands															
SD-28 (99)	08/09/99	0 - 0.5	<8 UJ	<520	<8 UJ	<520	<8	<8	60 J EB	<8	<8 UJ	<8	<8	<8	
WS-7 (04)	11/09/04	0 - 1	<8.9 UJ	<8.9 UJ	<8.9 UJ	<8.9 UJ	<18 U	<18	95	<1.8	<18	<1.8	<3.6	<1.8	<8.9
WS-10 (04)	11/18/04	0 - 2	2.4 J	<6.6 UJ	<6.6 UJ	<6.6 UJ	17 J	<13 UJ	72 J	18 J	<16 U	1.3 J	24 J	1.3 J	<6.6 UJ
WS-11 (04)	11/18/04	0 - 2	R	R	R	R	280 J	R	840 J	R	R	R	R	R	R
WS-15 (04)	11/18/04	0 - 2	26 J	12 J	14 J	62 J	21 J	<12 UJ	97 J	22 J	<13 U	160 J	<2.4	<1.2 UJ	5.9 J
WS-16 (04)	11/18/04	0 - 2	<8.2	<8.2	<8.2	<8.2	38 J	R	150 J	<1.6	<16 U	<1.6	<3.3	R	<8.2
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit. U = laboratory result qualified as estimated due to blank contamination. R = result rejected upon validation.															

Table 5-4d

Concentrations of VOCs in Sediment (ug/kg)
Sutton Brook and Associated Tributaries and Wetland Areas
Remedial Investigation and Feasability Study
Sutton Brook Disposal Area Superfund Site

Sample Location	Sample Date	Depth (ft)	Ethyl benzene	Isopropyl benzene	Methylene chloride	n-Butyl benzene	n-Propyl benzene	o-Xylene	p/m-Xylene	p-Isopropyl toluene	sec-Butyl benzene	Tetrachloro ethene	Tetrahydro furan	Toluene	Trichloro ethene	Xylenes (total)
Sutton Brook																
SD-01 (89)	10/26/89	0 - 0	17		<30							<10		4 J	<10	32
SD-03 (89)	10/26/89	0 - 0	<10		<10 UJ							<10		<10	<10	<10
SD001 (95)	10/30/95	0 - 0.5			28											
SD003 (95)	10/30/95	0 - 0.5			24											
SD-20 (99)	08/10/99	0 - 0.5	<7	<7 UJ	<7	<7 UJ	<7 UJ	<7	<7	<7 UJ	<7 UJ	<7		<7	<7	
SD-21 (99)	08/10/99	0 - 0.5	1300 J	110 J	<4 UJ	<4 UJ	78 J	120	1900 J	23 J	<4 UJ	<4 UJ		460	<4 UJ	
SD-22 (99)	08/09/99	0 - 0.5	3300	250 J	<8	<8 UJ	120 J	200	10000	16 J	5 J	<8		35	<8	
SD-23 (99)	08/09/99	0 - 0.5	1000	150 J	<20	<20 UJ	18 J	190 J	3500	<20 UJ	<20 UJ	<20 UJ		22	<20	
SD-24 (99)	08/09/99	0 - 0.5	R	15 J	6 J	23 J	R	R	6 J	R	R	R		R	R	
SD-25 (99)	08/09/99	0 - 0.5	<10	<10 UJ	<10	<10 UJ	<10 UJ	<10	<10	<10 UJ	<10 UJ	<10		<10	<10	
SD-26 (99)	08/09/99	0 - 0.5	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6		<6	<6	
SD-31 (04)	10/22/04	0 - 0.5	<50	<50	<500	<50	<50	<50	<50	<50	<50	<50	<1000	<75	<50	
SD-32 (04)	10/22/04	0 - 0.5	<110	580	<1100	<110	690	<110	170	<110	<110	<110	<2200	<170	<110	
SD-33 (04)	10/22/04	0 - 0.5	540 J	66 J	<360	130	210 J	570 J	1700 J	140	<36	<36	<720	4800 J	62	
SD-34 (04)	10/22/04	0 - 0.5	170	140	<600	<60	67	88	2900	85	<60	<60	<1200	<90	<60	
SD-35 (04)	10/22/04	0 - 0.5	<45	<45	<450	<45	<45	<45	<45	<45	<45	<45	<910	<68	<45	
SD-36 (04)	10/21/04	0 - 0.5	<66	<66	<660	<66	<66	<66	<66	<66	<66	<66	<1300	<100	<66	
SD-37 (04)	10/21/04	0 - 0.5	<49	<49	<490	<49	<49	<49	<49	<49	<49	<49	<980	<73	<49	
SD-214 (06)	11/09/06	0 - 0.5	<0.89	<0.89	<8.9 U	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<18	1.1 J	<0.89	
SD-215 (06)	11/09/06	0 - 1	<1	<1	<10 U	<1	<1	<1	<1	<1	<1	<1	<20	<1.5	<1	
Associated Tributaries																
SD-14 (99)	08/10/99	0 - 0.5	R	R	R	R	R	R	R	R	R	R		370 J	R	
SD-16 (99)	08/09/99	0 - 0.5	<12 UJ	<12 UJ	<12	<12 UJ	<12 UJ	<12 UJ	<12 UJ	<12 UJ	<12 UJ	<12 UJ		<12	<12	
SD-38 (04)	11/18/04	0 - 2	R	R	R	R	R	R	R	R	R	R	R	R	R	
SD-43 (04)	10/22/04	0 - 0.5	<60	<60	<600	<60	<60	<60	<60	<60	<60	<60	<1200	<90	<60	
Associated Wetlands																
SD-28 (99)	08/09/99	0 - 0.5	<8	<8 UJ	<8	<8 UJ	<8 UJ	<8	<8	<8 UJ	<8 UJ	<8		3 J	<8	
WS-7 (04)	11/09/04	0 - 1	<1.8 UJ	<1.8 UJ	<18	<1.8 UJ	<1.8 UJ	<1.8 UJ	<1.8 UJ	<1.8 UJ	<1.8 UJ	<1.8	<36	3.9	<1.8	
WS-10 (04)	11/18/04	0 - 2	9.1 J	<1.3 UJ	<13 UJ	<1.3 UJ	<1.3 UJ	<1.3 UJ	150 J	<1.3 UJ	<1.3 UJ	<1.3 UJ	25 J	13 J	<1.3 UJ	
WS-11 (04)	11/18/04	0 - 2	6.7 J	R	R	R	R	71 J	62 J	R	R	R	R	35 J	R	
WS-15 (04)	11/18/04	0 - 2	7 J	350 J	<12	<1.2	75 J	29 J	56 J	11 J	7 J	<1.2 UJ	210 J	14 J	<1.2 UJ	
WS-16 (04)	11/18/04	0 - 2	<1.6	<1.6	<16	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	R	<33	3.9 J	R	
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit. U = laboratory result qualified as estimated due to blank contamination. R = result rejected upon validation.																

Table 5-4e

Concentrations of SVOCs in Sediment (ug/kg)
Sutton Brook and Associated Tributaries and Wetland Areas
Remedial Investigation and Feasability Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	2-Methyl phenol	3-Methylphenol/ 4-Methylphenol	Anthracene	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzoic Acid	Bis(2-Ethylhexyl)p hthalate	Chrysene	Di-n-octyl phthalate	Fluoranthene	Naphthalene	Perylene	Phenanthrene	Pyrene
Sutton Brook																		
SD-01 (89)	10/26/89	0 - 0	<430		<430	<860	<430 UJ	<430 UJ	<430 UJ	<2100	570	<430	360 J	48 J	<430		<430	58 J
SD-03 (89)	10/26/89	0 - 0	<400		49 J	100 J	80 J	87 J	85 J	<1900	41 J	110 J	<400	280 J	<400		200 J	200 J
SD-20 (99)	08/10/99	0 - 0.5	<430		<430	<430	<440	<430	<430		<430	<430	<430	<430	<430		<430	<430
SD-21 (99)	08/10/99	0 - 0.5	240 J		<350	<350	<350	<350	<350		<350	<350	<350	<350	<350		<350	<350
SD-22 (99)	08/09/99	0 - 0.5	<570		<570	<570	<570	<570	<570		<570	<570	<570	<570	380 J		<570	<570
SD-23 (99)	08/09/99	0 - 0.5	<890		<890	<890	<890	<890	<890		450 J	<890	<890	<890	370 J		<890	<890
SD-24 (99)	08/09/99	0 - 0.5	<660		<660	<660	<660	<660	<660		<660	<660	<660	<660	<660		<660	<660
SD-25 (99)	08/09/99	0 - 0.5	<670		<670	<670	<670	<670	<670		<670	<670	<670	<670	<670		<670	<670
SD-26 (99)	08/09/99	0 - 0.5	<460		<460	<460	<460	<460	<460		<460	<460	<460	<460	<460		<460	<460
SD-31 (04)	10/22/04	0 - 0.5	<530	<530	<440	<440	<440	<440	<440	<4400	<890	<440	<440	<440	<250	<440	<440	<440
SD-32 (04)	10/22/04	0 - 0.5	<690	<690	<570	<570	<570	<570	<570	<5700	<1100	<570	<570	<570	1500	<570	<570	<570
SD-33 (04)	10/22/04	0 - 0.5	<510	1200	<430	<430	<430	<430	<430	<4300	6400	<430	650	<430	290	<430	<430	<430
SD-34 (04)	10/22/04	0 - 0.5	<700	<700	<580	<580	<580	<580	<580	<5800	<1200	<580	<580	<580	500	<580	<580	<580
SD-35 (04)	10/22/04	0 - 0.5	<560	<560	<470	<470	<470	<470	<470	<4700	<940	<470	<470	<470	<230	<470	<470	<470
SD-36 (04)	10/21/04	0 - 0.5	<560	<560	<460	<460	<460	<460	<460	<4600	<920	<460	<460	<460	<330	<460	<460	<460
SD-37 (04)	10/21/04	0 - 0.5	<490	<490	<410	<410	<410	<410	<410	<4100	<810	<410	<410	<410	<240	<410	<410	<410
SD-214 (06)	11/09/06	0 - 0.5	<210	<210	<170	<170	<170	<170	<170	<1700	<350	<170	<170	<170	<170	<170	<170	<170
SD-215 (06)	11/09/06	0 - 1	<220	<220	<180	<180	<180	<180	<180	<1800	<370	<180	<180	<180	<180	220	<180	<180
Associated Tributaries																		
SD-14 (99)	08/10/99	0 - 0.5	<660		<660	<660	440 J	<660	<660		<660	<660	<660	<660	<660		<660	<660
SD-16 (99)	08/09/99	0 - 0.5	<590		<590	<590	<590	<590	<590		<590	<590	<590	<590	<590		<590	<590
SD-38 (04)	11/18/04	0 - 2	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
SD-43 (04)	10/22/04	0 - 0.5	<560	<560	<470	<470	<470	<470	<470	<4700	<940	<470	<470	<470	<470	<470	<470	<470
Associated Wetlands																		
SD-28 (99)	08/09/99	0 - 0.5	<520		<520	<520	<520	<520	<520		<520	<520	<520	<520	<520		<520	<520
WS-7 (04)	11/09/04	0 - 1	<800	<800	<670	<670	<670	<670	<670	<6700	450 J	<670	<670	<670	<8.9 UJ	<670	<670	<670
WS-10 (04)	11/18/04	0 - 2	<820	<820	<680	<680	<680	<680	<680	<6800	<1400	<680	<680	<680	<6.6 UJ	<680	<680	<680
WS-11 (04)	11/18/04	0 - 2	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
WS-15 (04)	11/18/04	0 - 2	<730	<730	<610	<610	<610	<610	<610	<6100	<1200	<610	<610	<610	330 J	<610	<610	<610
WS-16 (04)	11/18/04	0 - 2	<890	<890	<740	<740	<740	<740	<740	<7400	<1500	<740	<740	<740	<8.2	<740	<740	<740
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit. R = result rejected upon validation.																		

Table 5-4f

Concentrations of Metals in Sediment (mg/kg)
Sutton Brook and Associated Tributaries and Wetland Areas
Remedial investigation and Feasability Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Aluminum, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Cyanide, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Selenium, Total	Sodium, Total	Vanadium, Total	Zinc, Total
Sutton Brook																							
SD-01 (89)	10/26/89	0 - 0	3320	7	16.3	<0.25	<1.23	3320 J	8.1	2.4 J	8 J		6110	25.1	1160	82 J	<0.12	6.6 J	<225		77	7.3	44.3
SD-03 (89)	10/26/89	0 - 0	3240	13 J	12.6	<0.29	<1.44	1080 J	8	3.4 J	31.3 J		4600	18	1150	46.1 J	<0.14	<7.5	<284.94		45	7.6	25.7 J
SD001 (95)	06/27/95	0 - 0.5		2.8	<0.01		<0.01		7.7		7.7	<0.02	4650	<0.05		86	0.06						33
SD002 (95)	06/27/95	0 - 0.5		82.3	<0.01		<0.01		<0.01		9.8	<0.02	3920	<0.05		33	0.71						12
SD003 (95)	06/27/95	0 - 0.5		6.48	<0.01		<0.01		5.9 J		5.9	1.4 J	5880	<0.05		75	0.16 J						24
SD-20 (99)	08/10/99	0 - 0.5	4090	62.1 J	24.4	<0.49 UJ	<0.1	1020	11.4 J	5.7	4.5 J	<0.4	9060 J	7.8	1930	103	<0.06	6.1 J	543		261	9.6	19.7
SD-21 (99)	08/10/99	0 - 0.5	3090	8.3 J	23.4	<0.19 UJ	<0.08	2840	7.7 J	1.6	39.9	<0.4	15100 J	32	1220	171	<0.05	9.3 J	230		233	5.8	58.4
SD-22 (99)	08/09/99	0 - 0.5	4430	43.8 J	22.6	<0.6	<0.14	3630	9.4	6	4.7 J	<0.36	15800 J	11 J	1130	176	<0.08 UJ	4.6 J	356		463	6.6	19.6
SD-23 (99)	08/09/99	0 - 0.5	6370	21.4 J	16.8	<0.86	<0.23	2280	10.3	0.87 J	<3.6 UJ	<0.59	5880 J	6.3 J	1100	92.9	<0.13 UJ	2.5 J	272		594	11.7	<10.5
SD-24 (99)	08/09/99	0 - 0.5	5160	48.9 J	37.1	<0.7	0.46	5200	9	3.8 J	10.5	<0.82	5470 J	21.6 J	1090	260	0.11 J	5.5 J	202		476	15.1	51.2
SD-25 (99)	08/09/99	0 - 0.5	1730	4.6 J	14.2	<0.36	<0.16	3830	2.9	0.83 J	<0.55 UJ	<0.79	2690 J	2.7 J	727	145	<0.1 UJ	<0.52 UJ	163		262 J	2.7	<6.3
SD-26 (99)	08/09/99	0 - 0.5	4030	23.4 J	18.4	<0.28	<0.11	898	19.6	3.3	13.3	<0.51	18400 J	15.2 J	1490	134	<0.05 UJ	6.7 J	638		187 J	8.9	44.2
SD-31 (04)	10/22/04	0 - 0.5	2300	7.2	8.7	<0.26	<0.26 UJ	610 J	4 J	2.3	1.8 J		2700	6.4	700	62	<0.09	4 J	250	<0.53	<100	4.8	14 J
SD-32 (04)	10/22/04	0 - 0.5	2500	55	24	0.34 J	0.37 J	2200 J	6.8 J	4.4	9.8 J		4800	27	850	41	<0.12	5.9 J	490	<0.68	360	8.3	31 J
SD-33 (04)	10/22/04	0 - 0.5	3700	160	19	<0.25	0.44 J	2400 J	9.8 J	18	110 J		15000	120	730	550	<0.08	15 J	300	<0.5	130	6.1	240 J
SD-34 (04)	10/22/04	0 - 0.5	3400	78	20	<0.35	<0.35 UJ	1500 J	6.8 J	3.7	9.7 J		7200	17	860	79	<0.1	6.6 J	310	<0.7	<140	6.6	35 J
SD-35 (04)	10/22/04	0 - 0.5	2700	14	13	<0.28	<0.28 UJ	830 J	6.6 J	2.7	3.5 J		3100	3.6	900	46	<0.08	7.2 J	350	<0.56	<110	7.3	13 J
SD-36 (04)	10/21/04	0 - 0.5	1600	39	8.4	<0.28	<0.28 UJ	570 J	4.2 J	2.2	1.4 J		6100	5.2	620	38	<0.07	3.9 J	160	<0.55	<110	4.5	7.7 J
SD-37 (04)	10/21/04	0 - 0.5	2100	9.4	12	<0.24	<0.24 UJ	1000 J	5.3 J	3.3	7.9 J		6500	9	1200	81	<0.08	5.8 J	360	<0.49	<97	6.2	19 J
SD-208 (06)				7.1 J									2200 J										
SD-209 (06)				9.5 J									3700 J										
SD-210 (06)				140 J									15000 J										
SD-211 (06)				29 J									3800 J										
SD-212 (06)				74 J									18000 J										
SD-213 (06)				92 J									27000 J										
SD-214 (06)	11/09/06	0 - 0.5	1900	8.4 J	9.3	0.084 J	0.2 J	690 J	3.2	2.2	2.3		3200	8	520	66	<0.04	3.8	150	<0.55	<110	3.2	29
SD-215 (06)	11/09/06	0 - 1	3900	26 J	13	0.043 J	0.067 J	1200 J	7.1	1.5	1.7		2100	2.5 J	950	45	<0.05	3.9	210	<0.58	<120	6.2	7.8
Associated Tributaries																							
SD-14 (99)	08/10/99	0 - 0.5	3150	406 J	24.5	<0.78 UJ	<0.18	4760	4.5 J	1.1	<4.4 UJ	<1.6	49300 J	<2.5	354	57.8	<0.09	8.2 J	74.5		225	9.8	4.6 J
SD-15 (99)	08/10/99	0 - 0.5	6790	767 J	54.3	<0.99 UJ	<0.18	7770	12.2 J	2.2	8.8 J		85300 J	<5.5	900	118	0.11 J	6.2 J	195		381	21.2	6.5 J
SD-16 (99)	08/09/99	0 - 0.5	3560	9.7 J	19.5	<0.57	0.17 J	1280	8.6	2.1 J	<2.7 UJ	<0.7	4360 J	6.5 J	922	31.4	<0.09 UJ	4.5 J	176		274 J	7.8	14.4
SD-17 (99)	08/09/99	0 - 0.5	2160	10.7 J	12.3	<0.41	<0.14	826	5.5	1.7 J	<0.49 UJ		3200 J	3 J	886	28.1	<0.09 UJ	2.5 J	181		<171	4.8	<9
SD-38 (04)	11/18/04	0 - 2	4100	64 J	34 J	0.69 J	0.53 J	3300 J	9.4 J	4.7 J	8.1 J		7700 J	17 J	820 J	180 J	R	9.8 J	190 J	1.7 J	140 J	9.5 J	28 J
SD-43 (04)	10/22/04	0 - 0.5	2500	88	10	<0.28	<0.28 UJ	860 J	5.1 J	2.2	2.1 J		9700	<2.8	800	41	<0.11	5.0 J	370	<0.56	<110	5.5	5.0 J
SD-202 (06)				9.4 J									9200 J										
SD-203 (06)				42 J									11000 J										
SD-204 (06)				130 J									21000 J										
SD-205 (06)				58 J									15000 J										
SD-206 (06)				58 J									8000 J										
SD-207 (06)				94 J									11000 J										
Associated Wetlands																							
SD-28 (99)	08/09/99	0 - 0.5	3350	9.3 J	18.9	<0.92	<0.12	2960	4.4	0.54 J	<0.47 UJ	<0.68	2910 J	5 J	438	148	<0.07 UJ	<0.4 UJ	245		515	2.2	<8.5
WS-7 (04)	11/09/04	0 - 1	2000	2.4 J	18	0.3 J	0.13 J	2000	4.3	0.73 J	5.6		2200	17	200	70	0.032 J	2.2	84 J	0.59 J	55 J	3	12
WS-10 (04)	11/18/04	0 - 2	6000	7.7	32	0.27 J	0.18 J	2200	12	2.6	4		4200	9.3	1600	97	<0.15	6.7	370	0.54 J	190	8.4	19
WS-11 (04)	11/18/04	0 - 2	7300 J	14 J	27 J	2.1 J	1.5 J	4400 J	13 J	4.2 J	12 J		1600 J	8.1 J	620 J	54 J	R	15 J	110 J	5.1 J	190 J	28 J	14 J
WS-15 (04)	11/18/04	0 - 2	3700	7.3	34	0.5	0.16 J	3300	7.9	1.6	4.3		5100	4.4	1400	190	<0.14	4.5	650	0.8	710	5.4	8.9
WS-16 (04)	11/18/04	0 - 2	4900	2.1	16	0.26 J	0.11 J	1200	8.6	1.3 J	2.9		2600	10	870	40	<0.18	4	140 J	0.73 J	61 J	6.6	11

NOTE:

mg/kg = micrograms per kilogram.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

J = estimated concentration.

UJ = estimated reporting limit.

R = result rejected upon validation.

Table 5-4g

**Summary of Stream Profile Data, Surface Water Samples
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

SURFACE WATER LOCATIONS October/November 2004	DESCRIPTION	TEMP (°C)	SPECIFIC CONDUCTIVITY (mS/cm)	DISSOLVED OXYGEN (mg/L)	pH (S.U.)	ORP (mV)	TURBIDITY (NTU)
Sutton Brook							
Tributaries							
SW/SD-30	Upgradient of Site/Access Road						
SW-65	Upgradient of Site/Access Road						
SW-64	Upgradient of Site/WP-4						
SW/SD-31(04)	Upgradient of Site/East of Northern Lobe	10.2	0.400	7.25	6.15	NM	2
SW-63	Upgradient of Site/East of Northern Lobe						
SW/SD-43(04)	Tributary from Compost Area	8.9	0.153	8.90	5.94	NM	8
SG-H	Tributary from Compost Area at SB						
SW-62	Upgradient of Crossing/Southeast of Northern Lobe						
SW/SD-32(04)	Upgradient of Crossing/Southeast of Northern Lobe	9.12	0.368	6.18	6.29	NM	4
SW-61	Upgradient of Crossing/Southeast of Northern Lobe						
SG-A	Downgradient of Crossing/Between Lobes						
SW-60	Downgradient of Crossing/Between Lobes						
SW-59	Downgradient of Crossing/Between Lobes						
SW/SD-33	Downgradient of Crossing/Between Lobes	9.2	0.392	5.40	6.04	NM	11
SW-58	Downgradient of Crossing/Between Lobes						
SW-57	Downgradient of Crossing/Between Lobes						
SW-56	Downgradient of Crossing/Between Lobes						
SW-55	Downgradient of Crossing/Between Lobes						
SW/SD-34(04)	Downgradient of Crossing/Between Lobes	5.7	0.538	5.83	6.04	NM	10
SW-54	Downgradient and West of Northern and Southern Landfill Lobes						
SW/SD-35(04)	Downgradient of Former Drum Disposal Area	8.3	0.438	2.88	5.78	NM	15
SW-53	Tributary from Town Wellfield						
SG-G	Tributary from Town Wellfield at SB						
SW/SD-36	Downgradient of Former Drum Disposal Area	9.1	0.375	2.43	6.21	NM	10
SW-52	Downgradient of Beaver Dam						
SW-50	Downgradient of Beaver Dam						
SW/SD-38(04)	Tributary from Farm across Former Drum Disposal Area	9.50	0.449	4.00	5.98	NM	10
SG-D	Tributary from Farm at SB						
SW/SD003(95)	Downgradient of Site before South Street						
SW/SD-37	Downgradient of Site/South Street	6.4	0.456	4.00	4.40	NM	10

Table 5-4g

**Summary of Stream Profile Data, Surface Water Samples
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

SURFACE WATER LOCATIONS September 2005	DESCRIPTION	TEMP (°C)	SPECIFIC CONDUCTIVITY (mS/cm)	DISSOLVED OXYGEN (mg/L)	pH (S.U.)	ORP (mV)	TURBIDITY (NTU)
Sutton Brook							
Tributaries							
SW/SD-30	Upgradient of Site/Access Road	15.21	0.803	5.60	6.30	49	NM
SW-65	Upgradient of Site/Access Road	14.98	0.799	4.44	6.48	46	NM
SW-64	Upgradient of Site/WP-4	15.86	0.746	7.12	7.07	49	NM
SW/SD-31(04)	Upgradient of Site/East of Northern Lobe	15.65	0.763	5.92	6.99	47	NM
SW-63	Upgradient of Site/East of Northern Lobe	15.15	0.522	4.58	6.95	45	NM
SW/SD-43(04)	Tributary from Compost Area	16.71	0.638	2.97	6.53	52	NM
SG-H	Tributary from Compost Area at SB	16.14	0.463	5.63	8.06	25	NM
SW-62	Upgradient of Crossing/Southeast of Northern Lobe	15.12	0.582	3.99	6.77	63	NM
SW/SD-32(04)	Upgradient of Crossing/Southeast of Northern Lobe	15.28	1.113	3.52	6.75	80	NM
SW-61	Upgradient of Crossing/Southeast of Northern Lobe	13.65	1.296	3.07	6.84	80	NM
SG-A	Downgradient of Crossing/Between Lobes	13.96	1.387	3.15	7.27	70	NM
SW-60	Downgradient of Crossing/Between Lobes	13.93	1.570	1.75	6.59	66	NM
SW-59	Downgradient of Crossing/Between Lobes	14.97	1.463	2.30	5.81	69	NM
SW/SD-33	Downgradient of Crossing/Between Lobes	15.62	1.450	0.98	6.50	51	NM
SW-58	Downgradient of Crossing/Between Lobes	19.38	1.249	2.57	6.41	84	NM
SW-57	Downgradient of Crossing/Between Lobes	19.25	1.129	1.28	6.20	67	NM
SW-56	Downgradient of Crossing/Between Lobes	19.10	1.254	2.01	6.17	38	NM
SW-55	Downgradient of Crossing/Between Lobes	18.55	1.169	2.25	6.66	76	NM
SW/SD-34(04)	Downgradient of Crossing/Between Lobes	18.34	1.013	3.75	7.17	76	NM
SW-54	Downgradient and West of Northern and Southern Landfill Lobes	20.57	1.109	1.08	6.61	59	NM
SW/SD-35(04)	Downgradient of Former Drum Disposal Area	17.58	1.031	3.94	6.47	62	NM
SW-53	Tributary from Town Wellfield	20.05	0.446	5.08	5.50	63	NM
SG-G	Tributary from Town Wellfield at SB	19.77	0.455	1.34	5.78	46	NM
SW/SD-36	Downgradient of Former Drum Disposal Area	21.48	0.824	6.50	7.08	53	NM
SW-52	Downgradient of Beaver Dam	14.97	0.865	2.60	6.55	41	NM
SW-50	Downgradient of Beaver Dam	14.82	0.857	4.06	6.86	60	NM
SW/SD-38(04)	Tributary from Farm across Former Drum Disposal Area	14.00	0.855	3.43	6.44	70	NM
SG-D	Tributary from Farm at SB	13.39	0.637	3.00	6.40	49	NM
SW/SD003(95)	Downgradient of Site before South Street	14.76	0.819	4.76	6.51	58	NM
SW/SD-37	Downgradient of Site/South Street	15.35	0.825	3.68	6.42	72	NM

Table 5-4g

**Summary of Stream Profile Data, Surface Water Samples
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts**

SURFACE WATER LOCATIONS Pre-ROD Locations	DESCRIPTION	Date Sampled	TEMP (°C)	SPECIFIC CONDUCTIVITY (mS/cm)	DISSOLVED OXYGEN (mg/L)	pH (S.U.)	ORP (mV)	TURBIDITY (NTU)
SW/SD-30	Upgradient of Site/Access Road	11/23/04	NM	NM	NM	NM	NM	NM
		09/22/05	15.21	0.803	5.60	6.30	49	NM
		02/16/06	4.03	0.589	14.04	6.90	96	1.86
		10/05/06	16.28	0.454	8.62	7.10	54	20.8
SW/SD-33	Downgradient of Crossing/Between Lobes	10/22/04	9.2	0.392	5.40	6.04	NM	11
		09/22/05	15.62	1.450	0.98	6.50	51	NM
		02/16/06	2.54	0.508	11.74	6.91	91	13.7
		10/05/06	14.54	0.634	6.64	7.15	-11	NM
SW/SD-36	Downgradient of Former Drum Disposal Area	10/21/04	9.1	0.375	2.43	6.21	NM	10
		09/22/05	21.48	0.824	6.50	7.08	53	NM
		02/16/06	4.01	0.416	12.49	7.17	51	2.52
		10/05/06	15.41	0.568	1.93	6.72	-49	16.5
SW/SD-37	Downgradient of Site/South Street	10/21/04	6.4	0.456	4.00	4.40	NM	10
		09/22/05	15.35	0.825	3.68	6.42	72	NM
		02/16/06	2.23	0.483	11.71	6.83	91	4.31
		10/05/06	15.66	0.539	5.15	6.99	22	13.2
NOTE: NM = Not measured °C = degrees Celsius S.U. = standard units mS/cm = millisiemens per centimeter at 25°C. mg/l = milligrams per liter ORP = Redox potential mV = millivolts NTU = nephelometric turbidity unit								

Table 5-4h

Concentrations of VOCs in Wetland Soil (ug/kg)
Sutton Brook and Associated Tributaries and Wetland Areas
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	2-Butanone	Acetone	Benzene	Carbon disulfide	Chlorobenzene	Chloroethane	cis-1,2-Dichloroethene	Ethyl Ether	p-Isopropyl toluene	Toluene
SD-12 (99)	08/10/99	0 - 0.5	<26	220 J	<26	<26 UJ	<26	<26	<26		<26 UJ	22 J
GP-7 (04)	11/09/04	0 - 1	89 J	330 J	5.2 J	<22 U	9.5 J	29 J	<2.2 UJ	<11	R	69 J
GP-8 (04)	11/08/04	0 - 1	<10 U	45	<1	<10	<1	<2	<1	<5.1	10 J	4.3
SS-5 (04)	11/18/04	0 - 2	44 UJ	200 J	<2.1 UJ	21 UJ	<2.1	<4.2 UJ	6.1 J	<11 UJ	<2.1	R
WS-6 (04)	11/08/04	0 - 1	<8.7 U	29	<0.87	<8.7	<0.87	<1.7	<0.87	<4.3	<0.87	<1.3
SS-9 (04)	11/09/04	0 - 1	<38 U	170 J	17 J	<22 U	19 J	8.7 J	2.3 J	4.6 J	<2.2 UJ	<3.2

NOTE:

ug/kg = micrograms per kilogram.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

J = estimated concentration.

UJ = estimated reporting limit.

U = Laboratory result qualified as less than indicated limit based on blank contamination.

R = result rejected upon validation.

Table 5-4i

Concentrations of SVOCs in Wetland Soil (ug/kg)
Sutton Brook and Associated Tributaries and Wetland Areas
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(ghi) perylene	Benzo(k) fluoranthene	Benzoic Acid	Chrysene	Fluoranthene	Indeno (1,2,3-cd) Pyrene	Perylene	Phenanthrene	Pyrene
SD-12 (99)	08/10/99	0 - 0.5	1200	1200	1700	820 J	580 J		1400	2600	960 J		1500	2300
GP-7 (04)	11/09/04	0 - 1	<810	<810	<810	<810	<810	<8100	<810	<810	<810	<810	<810	<810
GP-8 (04)	11/08/04	0 - 1	<560	<560	<560	<560	<560	<5600	<560	<560	<560	<560	<560	<560
SS-5 (04)	11/18/04	0 - 2	<1100	<1100	<1100	<1100	<1100	<11000	<1100	<1100	<1100	<1100	<1100	<1100
WS-6 (04)	11/08/04	0 - 1	<460	<460	<460	<460	<460	<4600	<460	<460	<460	<460	<460	<460
SS-9 (04)	11/09/04	0 - 1	<830	<830	<830	<830	<830	780 J	<830	<830	<830	250 J	<830	<830
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. J = estimated concentration.														

Table 5-4j

Concentrations of Metals in Wetland Soil (mg/kg)
Sutton Brook and Associated Tributaries and Wetland Areas
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Aluminum, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Selenium, Total	Sodium, Total	Vanadium, Total	Zinc, Total
SD-12 (99)	08/10/99	0 - 0.5	7000	4.4 J	39.9	<0.62 UJ	<0.25	3700	12.3 J	2	27.8	7330 J	104	1460	136	0.24 J	5.6 J	512	<1.5 UJ	403	16	76.9
SD-13 (99)	08/10/99	0 - 0.5	9770	2.3 J	43.4	<0.84 UJ	0.21 J	2920	12.5 J	1.3	43.9	5000 J	73.5	1410	85.5	0.23 J	7 J	473	<1.2 UJ	311	16.1	73.4
GP-7 (04)	11/09/04	0 - 1	10000	3.1 J	23	4.2	0.3 J	4900	7.7	0.67 J	4.5	1200	20	660	980	0.058 J	3.1	340	1.2	210	2.6	5.8
GP-8 (04)	11/08/04	0 - 1	5200	4.2 J	10	0.12 J	<0.33	120	4.3	1 J	0.6 J	1900	5.6	420	12	0.032 J	2.8	110 J	0.34 J	39 J	4.5	4.8
SS-5 (04)	11/18/04	0 - 2	5300	6.6	20	0.95	0.26 J	1700	6.6	1.3 J	6.7	1200	25	470	13	0.046 J	3.4	200 J	1.8	110 J	12	7.1
WS-6 (04)	11/08/04	0 - 1	3800	6.7 J	9.5	0.5	0.03 J	610	4.6	0.99 J	1.6	1500	7.9	320	54	0.027 J	2	93 J	<0.55	29 J	2.8	7.6
SS-9 (04)	11/09/04	0 - 1	5400	30 J	25	1.3	0.46 J	4900	9.4	1.1 J	6.2	2700	9	600	170	0.071 J	3.2	250	1.1	170 J	3.8	11
WS-106 (05)	11/29/05	0 - 1	12000 J	14 J	43 J	3.6 J	1.2 J	8300 J	12 J	5.2 J	26 J	5300 J	82 J	880 J	460 J	0.3 J	9.3 J	180 J	2.4 J	560 J	11 J	67 J
WS-107 (05)	11/29/05	0 - 1	5000	17 J	26	<0.47	0.33 J	2100	7.7	8.6	12	8300	42 J	800	1000	0.073 J	8.6	220 J	0.63 J	220	10	71
NOTE: mg/kg = milligrams per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. J = estimated concentration. UJ = estimated reporting limit.																						

Table 5-4k

Concentrations of Metals Detected in Sediment (mg/kg)
South of the Southern Lobe (Pond)
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Aluminum, Total	Arsenic, Total	Barium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Nickel, Total	Potassium, Total	Thallium, Total	Vanadium, Total	Zinc, Total
SD-39 (04)	10/28/04	0 - 0.5	2900	15	7.6	400 J	4.4	2	3.5	4800	23 J	650	41	4.9	300	0.28 J	5.6	13 J
SD-40 (04)	10/22/04	0 - 0.5	3100	6.6	7.8	350 J	5.3 J	4.2	5.2 J	4200	3.2	850	98	7.5 J	340	<0.52	5.2	7.8 J
SD-41 (04)	10/22/04	0 - 0.5	2200	3.6	5.4	260 J	3.4 J	1.6	2.6 J	2400	31	510	37	3.6 J	210	<0.5	3.1	8 J
SD-42 (04)	10/28/04	0 - 0.5	2100	7.8	5.8	320 J	4	1.9	3.4	3600	2.9 J	650	36	5.2	280	0.29 J	3.8	6.7 J
NOTE: mg/kg = milligrams per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. J = estimated concentration.																		

Table 5-4I

Concentrations of Metals and Hardness Detected in Surface Water (mg/l)
South of the Southern Lobe (Pond)
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Aluminum		Barium		Calcium		Chromium		Cobalt		Copper		Iron		Lead	
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
SW-39 (04)	10/28/04	0 - 0.5	0.22	<0.042 U	0.015	0.006 J	2.3	1.9	<0.01	<0.01	0.001 J	<0.01	0.003 J	<0.01	1.1	0.22	0.012	<0.01
SW-40 (04)	10/22/04	0 - 0.5	0.33		0.01 J		2		0.002 J		<0.01		<0.01		1.6		0.022	
SW-41 (04)	10/22/04	0 - 0.5	<0.19 U		0.008 J		2		<0.01		<0.01		<0.01		1.1		0.011	
SW-42 (04)	10/28/04	0 - 0.5	<0.079 U		0.008 J		2.2		<0.01		<0.01		<0.01		0.54		0.0052 J	
NOTE: mg/l = milligrams per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. U = laboratory result qualified as non-detect due to blank contamination.																		

Table 5-4I

Concentrations of Metals and Hardness Detected in Surface Water (mg/l)
South of the Southern Lobe (Pond)
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Magnesium		Manganese		Nickel		Potassium		Silver	Sodium		Vanadium		Zinc		Hardness
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	
SW-39 (04)	10/28/04	0 - 0.5	0.95	0.8	0.43	0.02	<0.025	<0.025	0.92 J	0.74 J	<0.007	4.6	3.9	0.001 J	<0.01	0.035 J	0.007 J	9.8
SW-40 (04)	10/22/04	0 - 0.5	0.86		0.13		0.0026 J		0.84 J		0.0013 J	4.2		<0.01		0.009 J		8.5
SW-41 (04)	10/22/04	0 - 0.5	0.86		0.027		<0.025		0.81 J		0.01	4		<0.01		0.005 J		8.6
SW-42 (04)	10/28/04	0 - 0.5	0.9		0.03		<0.025		0.83 J		<0.007	4.5		<0.01		0.006 J		9.1
NOTE: mg/l = milligrams per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. U = laboratory result qualified as non-detect due to blank contamination.																		

Table 5-4m

Concentrations of VOCs Detected in Sediment (ug/kg)
South of the Southern Lobe (Wetland)
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	1,1-Dichloro ethane	1,2-Dichloro propane	1,2,4-Trimethyl benzene	1,3,5-Trimethyl benzene	2-Butanone	4-Methyl-2-pentanone	Acetone	Benzene	Carbon disulfide	Chloro ethane	Chloroform
SD-01 (99)	08/10/99	0 -0.5	R	R	35 J	R	R	82 J	580 J	18 J	R	29 J	R
SD-02 (99)	08/10/99	0 -0.5	31 J	27 J	36 J	R	R	61 J	1000 J	140 J	R	350 J	R
WS-101 (05)	12/01/05	0 - 1	R	R	R	R	110 J	R	1300 J EB	R	R	R	R
WS-102 (05)	12/01/05	0 - 1	7.6 J	R	R	R	160 J	R	2100 J EB	R	R	R	R
WS-103 (05)	12/01/05	0 - 1	R	R	9.9 J	R	160 J	R	1300 J EB	34 J	R	53 J	R
WS-104 (05)	12/01/05	0 - 1	38 J	R	12 J	14 J	170 J	R	>1200 J EB	14 J	R	38 J	6.8 J
WS-105 (05)	12/01/05	0 - 1	R	R	R	R	140 J	R	>1000 J EB	R	R	17 J	R
SD-216 (06)	11/09/06	0 - 0.5	R	R	77 J	26 J	610 J	R	4200 J	5 J	17 J	R	R
SD-217 (06)	11/09/06	0 - 0.5	R	R	R	R	480 J	R	4000 J	7 J	R	22 J	R
SD-218 (06)	11/09/06	0 - 1	3.5 J	R	R	R	530 J	R	4400 J	2.1 J	R	R	R
SD-219 (06)	11/09/06	0 - 0.5	R	R	R	R	520 J	R	4200 J	R	R	R	R
SD-220 (06)	11/09/06	0 - 1	<1.8	<4.3	R	R	6.9 J	<12	82 J	<1.2	<12	<2.4	<1.8
SD-221 (06)	11/09/06	0 - 0.5	R	R	R	R	190 J	R	1600 J	R	R	R	R
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated detection limit. EB = compound was detected in the associated equipment blank. R = result rejected upon validation.													

Table 5-4m

Concentrations of VOCs Detected in Sediment (ug/kg)
South of the Southern Lobe (Wetland)
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	cis-1,2-Dichloro ethene	Ethyl benzene	Isopropyl benzene	Methylene chloride	n-Propyl benzene	o-Xylene	p/m-Xylene	p-Isopropyl toluene	Tetrachloro ethene	Tetrahydro furan	Toluene
SD-01 (99)	08/10/99	0 - 0.5	R	140 J	18 J	R	17 J	130 J	320 J	R	R		29 J
SD-02 (99)	08/10/99	0 - 0.5	24 J	240 J	63 J	R	R	180 J	420 J	R	R		8400 J
WS-101 (05)	12/01/05	0 - 1	R	R	R	R	R	R	R	R	12 J	R	16 J
WS-102 (05)	12/01/05	0 - 1	R	R	R	R	R	R	R	8.2 J	R	R	R
WS-103 (05)	12/01/05	0 - 1	R	62 J	10 J	R	R	94 J	170 J	R	R	75 J	40 J
WS-104 (05)	12/01/05	0 - 1	40 J	47 J	38 J	R	24 J	23 J	81 J	4.7 J	12 J	R	8.5 J
WS-105 (05)	12/01/05	0 - 1	8.9 J	R	R	R	R	R	R	R	R	33 J	R
SD-216 (06)	11/09/06	0 - 0.5	R	39 J	10 J	R	11 J	45 J	65 J	R	R	47 J	100 J
SD-217 (06)	11/09/06	0 - 0.5	18 J	R	R	R	R	R	R	R	R	R	16 J
SD-218 (06)	11/09/06	0 - 1	R	2.2 J	R	R	R	R	4 J	R	R	R	42 J
SD-219 (06)	11/09/06	0 - 0.5	15 J	R	R	R	R	R	R	R	R	R	7.5 J
SD-220 (06)	11/09/06	0 - 1	<1.2	<1.2 UJ	<1.2 UJ	<1.2	<1.2	<1.2 UJ	<1.2 UJ	R	<1.2 UJ	<24	0.86 J
SD-221 (06)	11/09/06	0 - 0.5	R	R	R	R	R	R	R	R	R	R	7.9 J

NOTE:
ug/kg = micrograms per kilogram.
ft = feet below ground surface.
< = less than minimum reporting limit as indicated by the laboratory.
Bold indicates a concentration detected above the reporting limit.
A blank space indicates the sample was not analyzed for this constituent.
J = estimated concentration.
UJ = estimated detection limit.
EB = compound was detected in the associated equipment blank.
R = result rejected upon validation.

Table 5-4m

Concentrations of VOCs Detected in Sediment (ug/kg)
South of the Southern Lobe (Wetland)
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	trans-1,2-Dichloro ethene	Trichloroethene	Vinyl chloride
SD-01 (99)	08/10/99	0 -0.5	R	R	R
SD-02 (99)	08/10/99	0 -0.5	37 J	R	R
WS-101 (05)	12/01/05	0 - 1	R	R	R
WS-102 (05)	12/01/05	0 - 1	R	R	R
WS-103 (05)	12/01/05	0 - 1	R	R	R
WS-104 (05)	12/01/05	0 - 1	6.2 J	27 J	23 J
WS-105 (05)	12/01/05	0 - 1	R	R	R
SD-216 (06)	11/09/06	0 - 0.5	R	R	R
SD-217 (06)	11/09/06	0 - 0.5	R	R	R
SD-218 (06)	11/09/06	0 - 1	R	R	R
SD-219 (06)	11/09/06	0 - 0.5	R	R	R
SD-220 (06)	11/09/06	0 - 1	<1.8	<1.2	<2.4
SD-221 (06)	11/09/06	0 - 0.5	R	R	R
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated detection limit. EB = compound was detected in the associated equipment blank. R = result rejected upon validation.					

Table 5-4n

Concentrations of SVOCs Detected in Sediment (ug/kg)
South of the Southern Lobe (Wetland)
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Benzo(a)pyrene	Benzoic Acid	Bis(2-Ethylhexyl) phthalate
SD-01 (99)	08/10/99	0 - 0.5	530 J		<660
SD-02 (99)	08/10/99	0 - 0.5	<660 UJ		660 J
WS-101 (05)	12/01/05	0 - 1	R	2900 J	R
WS-102 (05)	12/01/05	0 - 1	R	3800 J	3800 J
WS-103 (05)	12/01/05	0 - 1	R	4900 J	R
WS-104 (05)	12/01/05	0 - 1	R	5500 J	R
WS-105 (05)	12/01/05	0 - 1	R	R	1400 J
SD-216 (06)	11/09/06	0 - 0.5	R	R	R
SD-217 (06)	11/09/06	0 - 0.5	R	R	R
SD-218 (06)	11/09/06	0 - 1	R	R	R
SD-219 (06)	11/09/06	0 - 0.5	R	R	R
SD-220 (06)	11/09/06	0 - 1	<200	200 J	<400
SD-221 (06)	11/09/06	0 - 0.5	R	R	R
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit. R = result rejected upon validation.					

Table 5-4o

Concentrations of Metals Detected in Sediment (mg/kg)
South of the Southern Lobe (Wetland)
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Aluminum, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total
SD-01 (99)	08/10/99	0 - 0.5	2580	27.9 J	71.6	<1.1 UJ	0.32 J	13900	3.4 J	3.2	15.8	24800 J
SD-02 (99)	08/10/99	0 - 0.5	2590	11 J	71.5	3.7 UJ	0.18 U	11000	2.7 J	4.5	9.3	14600 J
WS-101 (05)	12/01/05	0 - 1	2600 J	2.3 J	66 J	0.73 J	R	9500 J	1.6 J	2.2 J	9.2 J	9200 J
WS-102 (05)	12/01/05	0 - 1	1500 J	3.1 J	76 J	0.7 J	R	9500 J	1.6 J	1.6 J	8.7 J	4000 J
WS-103 (05)	12/01/05	0 - 1	1700 J	4.8 J	70 J	1.5 J	R	13000 J	1.9 J	1.2 J	7.7 J	5400 J
WS-104 (05)	12/01/05	0 - 1	1700 J	2 J	66 J	0.88 J	0.093 J	9600 J	1.6 J	1.1 J	9.2 J	1900 J
WS-105 (05)	12/01/05	0 - 1	1700 J	3.7 J	48 J	0.74 J	0.11 J	8300 J	2.3 J	1.4 J	8.7 J	9000 J
SD-216 (06)	11/09/06	0 - 0.5										
SD-217 (06)	11/09/06	0 - 0.5										
SD-218 (06)	11/09/06	0 - 1										
SD-219 (06)	11/09/06	0 - 0.5										
SD-220 (06)	11/09/06	0 - 1										
SD-221 (06)	11/09/06	0 - 0.5										

NOTE:

mg/kg = milligrams per kilogram.

ft = feet below ground surface.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

J = estimated concentration.

UJ = estimated reporting limit.

R = result rejected upon validation.

Table 5-4o

Concentrations of Metals Detected in Sediment (mg/kg)
South of the Southern Lobe (Wetland)
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Selenium, Total	Sodium, Total	Vanadium, Total	Zinc, Total
SD-01 (99)	08/10/99	0 - 0.5	75.6	1050	118	0.2 J	8.4 J	667		928	8.8	138
SD-02 (99)	08/10/99	0 - 0.5	22.9	819	341	0.13 J	2.6 J	133	2.4 UJ	979	13.6	8
WS-101 (05)	12/01/05	0 - 1	12 J	1400 J	210 J	0.12 J	5.8 J	260 J	1.8 J	240 J	4 J	R
WS-102 (05)	12/01/05	0 - 1	33 J	1200 J	180 J	0.22 J	3.9 J	540 J	1.8 J	360 J	6.4 J	R
WS-103 (05)	12/01/05	0 - 1	6.5 J	1500 J	330 J	0.084 J	2.9 J	140 J	1.8 J	180 J	4.7 J	R
WS-104 (05)	12/01/05	0 - 1	4.2 J	1600 J	76 J	0.08 J	3.1 J	260 J	1.6 J	310 J	3.9 J	R
WS-105 (05)	12/01/05	0 - 1	18 J	750 J	140 J	0.084 J	4 J	240 J	1.6 J	200 J	7.1 J	R
SD-216 (06)	11/09/06	0 - 0.5				0.3						
SD-217 (06)	11/09/06	0 - 0.5				0.14						
SD-218 (06)	11/09/06	0 - 1				0.2						
SD-219 (06)	11/09/06	0 - 0.5				0.19						
SD-220 (06)	11/09/06	0 - 1				<0.05						
SD-221 (06)	11/09/06	0 - 0.5				0.083 J						

NOTE:

mg/kg = milligrams per kilogram.

ft = feet below ground surface.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

J = estimated concentration.

UJ = estimated reporting limit.

R = result rejected upon validation.

Table 5-4p

Concentrations of VOCs Detected in Surface Water (ug/l)
South of the Southern Lobe (Wetland)
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	1,1-Dichloro ethane	1,4-Dioxane	Acetone	Chloro ethane	cis-1,2-Dichloro ethene	Ethyl Ether	Ethyl benzene	o-Xylene	p/m-Xylene	Tetrahydrofuran	Toluene
SW-101 (05)	12/01/05	0 - 0.5	<0.75	<5	6.8	<1	<0.5	<2.5	<0.5	<0.5	<0.5	0.86 J	2
SW-102 (05)	12/01/05	0 - 0.5	0.32 J	<5	1.8 J	<1	0.41 J	<2.5	<0.5	<0.5	<0.5	<10	<0.75
SW-103 (05)	12/01/05	0 - 0.5	<0.75	<5	1.9 J	<1	<0.5	<2.5	0.38 J	0.36 J	0.95	0.96 J	1.7
SW-105 (05)	12/01/05	0 - 0.5	<0.75	1.7 J	2.3 J	1.1	<0.5	0.5 J	<0.5	<0.5	<0.5	5.8 J	<0.75
SW-104 (05)	12/01/05	0 - 0.5	<0.75	<5	<5	<1	<0.5	<2.5	<0.5	<0.5	<0.5	1.3 J	<0.75
NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration.													

Table 5-4q

Concentrations of Metals and Hardness Detected in Surface Water (mg/l)
South of the Southern Lobe (Wetland)
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Aluminum		Antimony		Arsenic		Barium		Calcium		Cobalt	
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
SW-101 (05)	12/01/05	0 - 0.5	0.21	<0.096 U	<0.006	<0.006	<0.005	<0.005	0.04	0.03	23	21	0.003 J	0.003 J
SW-102 (05)	12/01/05	0 - 0.5	<0.098 U	<0.056 U	0.0051 J	0.0036 J	<0.005	<0.005	0.02	0.02	15	13	0.001 J	<0.01
SW-103 (05)	12/01/05	0 - 0.5	<0.093 U	<0.063 U	<0.006	<0.006	0.0039 J	<0.005	0.02	0.02	14	13	0.001 J	0.001 J
SW-105 (05)	12/01/05	0 - 0.5	0.16	<0.06 U	<0.006	<0.006	0.006	0.0036 J	0.03	0.02	13	12	0.001 J	0.001 J
SW-104 (05)	12/01/05	0 - 0.5	<0.099 U	<0.088 U	<0.006	<0.006	<0.005	<0.005	0.01	0.01	9.6	9.4	<0.01	<0.01
NOTE: mg/l = milligrams per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. U = laboratory result qualified as non-detect based on blank contamination.														

Table 5-4q

Concentrations of Metals and Hardness Detected in Surface Water (mg/l)
South of the Southern Lobe (Wetland)
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Copper		Iron		Lead		Magnesium		Manganese		Nickel		Potassium	
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
SW-101 (05)	12/01/05	0 - 0.5	0.01	0.004 J	6.7	5.3	0.011	<0.01	4.1	3.6	0.4	0.36	0.0083 J	0.007 J	6.8	5.9
SW-102 (05)	12/01/05	0 - 0.5	0.004 J	<0.01	4	0.66	0.012	<0.01	3.3	3	0.2	0.16	0.0016 J	0.0018 J	19	16
SW-103 (05)	12/01/05	0 - 0.5	0.004 J	<0.01	3.6	1.3	0.0074 J	<0.01	3.2	2.9	0.18	0.16	0.0023 J	0.0021 J	16	14
SW-105 (05)	12/01/05	0 - 0.5	0.005 J	<0.01	6.6	3.3	0.012	<0.01	2.8	2.6	0.26	0.23	0.0027 J	0.0015 J	10	9.4
SW-104 (05)	12/01/05	0 - 0.5	0.003 J	<0.01	1.4	0.98	0.0096 J	<0.01	2.5	2.4	0.06	0.06	0.0024 J	0.0025 J	9.4	9.1

NOTE:

mg/l = milligrams per liter.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

J = estimated concentration.

U = laboratory result qualified as non-detect based on blank contamination.

Table 5-4q

Concentrations of Metals and Hardness Detected in Surface Water (mg/l)
South of the Southern Lobe (Wetland)
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site

Sample Location Identifier	Sample Date	Depth (ft)	Sodium		Vanadium		Zinc		Hardness
			Total	Dissolved	Total	Dissolved	Total	Dissolved	
SW-101 (05)	12/01/05	0 - 0.5	8	7.3	0.002 J	0.001 J	0.17	<0.07 U	73
SW-102 (05)	12/01/05	0 - 0.5	17	15	0.002 J	0.001 J	0.1	<0.06 U	51
SW-103 (05)	12/01/05	0 - 0.5	16	14	0.001 J	<0.01	0.08	<0.09 U	49
SW-105 (05)	12/01/05	0 - 0.5	13	12	0.002 J	<0.01	0.1	<0.07 U	44
SW-104 (05)	12/01/05	0 - 0.5	13	13	0.001 J	0.001 J	0.09	<0.06 U	34
NOTE: mg/l = milligrams per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. U = laboratory result qualified as non-detect based on blank contamination.									

Table 5-4r

Concentrations of VOCs Detected in Groundwater (ug/l)
South of the Southern Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	1,1-Dichloroethane	1,2-Dichloroethane	1,4-Dioxane	2-Butanone	4-Methyl-2-pentanone	Acetone	Benzene	Chloroethane	cis-1,2-Dichloroethene	Ethyl Ether	Ethyl benzene
MW-15	07/07/99	18 - 28	<5	<5					<5	<5	<5		<5
	09/15/99		<10	<10		75 J	170 J	120 J	<10	<10 UJ			4 J
	11/15/04		<0.75	<0.5	<5	<5	<5	<5	<0.5	<1	<0.5	<2.5	<0.5
GP-19	11/03/04	3 - 13	<0.75	<0.5	<5	<5	<5	<5	<0.5	<1	<0.5	<2.5	<0.5
WP-6	12/28/05	1.5 - 3.5	<0.75	<0.5	<5	<5	<5	<5	<0.5	0.5 J	<0.5	0.42 J	<0.5
WP-7	12/28/05	8 - 10	5.4	3.7	48	<20	<20	<20	8.6	44	1.3 J	34	14
<p>NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit. R = result rejected upon validation.</p>													

Table 5-4r

Concentrations of VOCs Detected in Groundwater (ug/l)
South of the Southern Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	Methylene chloride	o-Xylene	p/m-Xylene	Tetrahydrofuran	Toluene	Xylenes (total)
MW-15	07/07/99	18 - 28	<10				<5	<5
	09/15/99		<10 UJ				20	12
	11/15/04		<5	<0.5	<0.5	<10	<0.75	
GP-19	11/03/04	3 - 13	<5	<0.5	<0.5	<10	<0.75	
WP-6	12/28/05	1.5 - 3.5	<5	<0.5	<0.5	1.9 J	<0.75	
WP-7	12/28/05	8 - 10	1.6 J	13	29	430	67	
NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit. R = result rejected upon validation.								

Table 5-4s

Concentrations of SVOCs Detected in Groundwater (ug/l)
South of the Southern Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	2-Methylphenol	Benzoic Acid	Benzyl Alcohol	Di-n-butylphthalate	Phenol
MW-15	07/07/99	18 - 28	<1	<10	<1	<0.75	0.559
	09/15/99		<10			<10	<10
	11/15/04		<6	<50	<10	<5	<7
WP-6	12/28/05	1.5 - 3.5	<6.1	10 J	<10	11	<7.1
WP-7	12/28/05	8 - 10	1.7 J	<55	1.9 J	1 J	<7.7
NOTE: ug/l = micrograms per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. J = estimated concentration. UJ = estimated reporting limit.							

Table 5-4t

Concentrations of Metals and Hardness in Groundwater (mg/l)
South of the Southern Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	Aluminum		Arsenic		Barium		Beryllium		Cadmium		Calcium		Chromium	
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
MW-15	07/07/99	18 - 28			0.24				0.009		0.02				<0.06	
	09/15/99		0.169		0.0613		<0.007		<0.0001		<0.0004		14.3	J	0.0007	
	11/15/04			<0.1		0.06		<0.01		<0.002		<0.002		11		<0.01
	12/08/04		<0.089	U		0.075		0.004	J		0.0004	J	<0.002		12	
GP-19	11/03/04	3 - 13			<0.005						<0.002					
WP-6	12/28/05	1.5 - 3.5	0.056	J		0.017		0.02			<0.002		15		<0.01	
WP-7	12/28/05	8 - 10	0.074	J		0.0039	J	0.37			<0.002		130		0.003	J

NOTE:

mg/l = milligrams per liter.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

B = analyte also detected in blank sample.

J = estimated concentration.

Table 5-4t

Concentrations of Metals and Hardness in Groundwater (mg/l)
South of the Southern Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	Cobalt		Copper		Iron		Lead		Magnesium		Manganese		Nickel	
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
MW-15	07/07/99	18 - 28			<0.008				<0.02						0.04	
	09/15/99		<0.0006		0.0022 J		5.82		<0.001		3.34		0.395 J		<0.0007	
	11/15/04			<0.01		<0.01		2.1		<0.01		2.7		0.3		<0.025
	12/08/04		<0.01		<0.01		4.4		<0.01		3		0.37		<0.025	
GP-19	11/03/04	3 - 13					0.37		<0.01		1		3.7			
WP-6	12/28/05	1.5 - 3.5	0.005 J		<0.01		44		<0.01		3.8		0.78		<0.025	
WP-7	12/28/05	8 - 10	0.001 J		<0.01		20		0.0087 J		35		1.5		0.0058 J	

NOTE:
mg/l = milligrams per liter.
ft = feet below ground surface.
< = less than minimum reporting limit as indicated by the laboratory.
Bold indicates a concentration detected above the reporting limit.
A blank space indicates the sample was not analyzed for this constituent.
B = analyte also detected in blank sample.
J = estimated concentration.

Table 5-4t

Concentrations of Metals and Hardness in Groundwater (mg/l)
South of the Southern Lobe
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Screened Interval (ft)	Potassium		Silver		Sodium		Vanadium		Zinc		Hardness
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	
MW-15	07/07/99	18 - 28			0.01						0.08		
	09/15/99		1.83 J		<0.0004		13.4 J		<0.0008		<0.0163		
	11/15/04			<2.5		<0.007		10		<0.01		<0.05	
	12/08/04		1.6 J		<0.007		10		0.001 J		0.005 J		
GP-19	11/03/04	3 - 13											10
WP-6	12/28/05	1.5 - 3.5	6.8				18		<0.01		24		
WP-7	12/28/05	8 - 10	29				71		0.001 J		55		
NOTE: mg/l = milligrams per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. B = analyte also detected in blank sample. J = estimated concentration.													

Table 5-6a

Concentrations of Metals in Sediment (mg/kg)
Reference Locations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Aluminum, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Cyanide, Total	Iron, Total	Lead, Total
SD-02 (89)	10/26/89	surface	4190	8.9	9.6	<0.26	<1.41	652 J	9.9	2.7 J	4 J		4500	2.9
SD-06 (99)	08/09/99	0 - 0.5	11000	41.1 J	75.4	<2	1.2	4670	18.9	19.3	28.5	0.88	17900 J	133 J
SD-07 (99)	08/09/99	0 - 0.5	8200	6.5 J	26.7	<1.6	0.24 J	3260	11.3	3.2	5.5 J		4260 J	24.3 J
SD-10 (99)	08/10/99	0 - 0.5	8550	30.8 J	52.6	<1 UJ	1.1	3320	14.2 J	15.3	24.1	<1.3	10200 J	142
SD-11 (99)	08/10/99	0 - 0.5	8820	26.1 J	50.4	<0.98 UJ	0.98	2920	15.2 J	13.5	24.7		11200 J	81.8
SD-30 (04)	11/23/04	0 - 0.5	3400	9.6	16	0.24 J	0.16 J	1500 J	5.9 J	4.1	3.3 J		3300	8.5
SD-18 (99)	08/09/99	0 - 0.5	1990	1.4 J	13.8	<0.34	<0.12	501	5.4	1.5 J	<1.2 UJ	<0.35	2930 J	5.9 J
SD-19 (99)	08/09/99	0 - 0.5	2470	<0.91	13.8	<0.21	<0.1	413	6.2	1.3 J	<0.82 UJ		3370 J	4.5 J
SD-30 (99)	08/09/99	0 - 0.5	3670	7 J	12.8	<0.48	<0.15	1230	7.1	2.5	<3.4 UJ	<0.69	4430 J	6.7 J
SD-31 (99)	08/09/99	0 - 0.5	5980	12 J	20.6	<0.54	<0.12	723	20.3	4.3	4.9	<0.55	8730 J	5 J
SD-33 (99)	08/09/99	0 - 0.5	3030	<1	14	<0.41	<0.12	648	6.7	1.3	<2.8 UJ	<0.61	2600 J	1.7 J
SD-200 (06)	11/10/06	0 - 0.5		5.4 J									5200 J	
SD-201(06)	11/10/06	0 - 0.5		110 J									8900 J	

NOTE:
mg/kg = milligrams per kilogram.
ft = feet below ground surface.
< = less than minimum reporting limit as indicated by the laboratory.
Bold indicates a concentration detected above the reporting limit.
A blank space indicates the sample was not analyzed for this constituent.
J = estimated concentration.
UJ = estimated reporting limit.

Table 5-6a

Concentrations of Metals in Sediment (mg/kg)
Reference Locations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Selenium, Total	Sodium, Total	Vanadium, Total	Zinc, Total
SD-02 (89)	10/26/89	surface	1590	77.6 J	<0.14	<7.32	<258.59		77.1	7.7	<18.8
SD-06 (99)	08/09/99	0 - 0.5	1440	2730	0.23 J	17.8	351		718	27	141
SD-07 (99)	08/09/99	0 - 0.5	927	282	0.12 J	3.7 J	224		663	10.7	19.9
SD-10 (99)	08/10/99	0 - 0.5	1410	448	0.1 J	12.7 J	474		704	23.1	132
SD-11 (99)	08/10/99	0 - 0.5	1710	425	<0.15 UJ	12.7 J	641		623	23.4	122
SD-30 (04)	11/23/04	0 - 0.5	850	140	0.011 J	4.1 J	150	0.47 J	81 J	5.3	17 J
SD-18 (99)	08/09/99	0 - 0.5	794	176	<0.07 UJ	2 J	233		169 J	4.1	19.4
SD-19 (99)	08/09/99	0 - 0.5	1050	114	<0.06 UJ	2.8 J	330		168 J	4.5	16.5
SD-30 (99)	08/09/99	0 - 0.5	1260	51.2	0.12 J	5.1 J	252		205 J	6.7	13.7
SD-31 (99)	08/09/99	0 - 0.5	2620	195	0.07 J	10.1 J	978		411	14.2	16.2
SD-33 (99)	08/09/99	0 - 0.5	984	39.1	0.07 J	2.1 J	165		305	5.1	<7.8
SD-200 (06)	11/10/06	0 - 0.5									
SD-201(06)	11/10/06	0 - 0.5									

NOTE:
mg/kg = milligrams per kilogram.
ft = feet below ground surface.
< = less than minimum reporting limit as indicated by the laboratory.
Bold indicates a concentration detected above the reporting limit.
A blank space indicates the sample was not analyzed for this constituent.
J = estimated concentration.
UJ = estimated reporting limit.

Table 5-6b

Concentrations of Metals Detected in Surface Water (mg/l)
Reference Locations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, MA

Sample Location Identifier	Sample Date	Depth (ft)	Aluminum		Antimony		Arsenic		Barium		Calcium		Cobalt		Copper		Iron	
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
SW-11 (99)	08/10/99	surface	0.536		<0.003		0.0055 J		0.0236		17.2		0.0023		0.0047		3.03	
SW-30	11/23/04	0 - 0.5	0.068 J		<0.006		<0.005		0.025		18		<0.01		<0.01		1.3	
	09/20/05		<0.054 U	<0.1	<0.0033 U	<0.006	0.0038 J	0.0042 J	0.04	0.03	28	27	<0.002 U	<0.002 U	<0.01	<0.01	0.95	0.25
SW-07 (99)	08/09/99	surface	<0.0471		<0.003		<0.003		0.0178		19		<0.001		<0.001		0.712	
SW-01 (99)	08/09/99	surface	<0.0181		0.256		<0.003		0.0209		17.9		<0.001		<0.001		0.499	
SW-222 (06)	11/09/06	0 - 0.5		0.1		<0.006		<0.005		0.01		6		<0.01		<0.01		0.27
NOTE: mg/l = milligrams per liter. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. A blank space indicates the sample was not analyzed for this constituent. U = result qualified as non-detect due to blank contamination. J = estimated concentration.																		

Table 5-6b

Concentrations of Metals Detected in Surface Water (mg/l)
Reference Locations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, MA

Sample Location Identifier	Sample Date	Depth (ft)	Lead		Magnesium		Manganese		Nickel		Potassium		Sodium		Vanadium		Zinc	
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
SW-11 (99)	08/10/99	surface	0.0057		3.85		0.558		0.0032		2.83		55.9		0.0015 J		0.0423	
SW-30	11/23/04	0 - 0.5	<0.01		4.6		0.28		<0.025		3.4		77		<0.01		0.014 J	
	09/20/05		<0.01	<0.01	5.6	5.4	0.33	0.35	0.0029 J	<0.0021 U	3.9	3.8	77	73	<0.001 U	<0.01	0.045 J	0.044 J
SW-07 (99)	08/09/99	surface	<0.001		4.15		0.424		<0.001		3.53		45.9		<0.001		0.0125	
SW-01 (99)	08/09/99	surface	<0.0051		3.89		0.197		<0.001		3.25		43		<0.001		0.0252	
SW-222 (06)	11/09/06	0 - 0.5		<0.01		1.5		0.04		0.0017 J		1.8 J		23		<0.01		0.025 J

NOTE:

mg/l = milligrams per liter.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

U = result qualified as non-detect due to blank contamination.

J = estimated concentration.

Table 5-6c

Concentrations of VOCs in Soils (ug/kg)
Reference Locations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	1,4-Dichloro benzene	2-Butanone	Acetone	Acrolein	Benzene	Carbon disulfide	Chloro methane	Methyl Acetate	Methylene chloride	p-Isopropyl toluene	Tetra hydrofuran	Toluene
SD-08 (99)	08/10/99	0 - 0.5	<350	<6	R		<6	<6 UJ	<6		<6	<6		<6
SS-01 (99)	08/04/99	0 - 0.5	<460	<20 UJ	180 J		<10 UJ	<10 UJ	<20 UJ		<10 UJ			<10 UJ
SS-1 (04)	11/23/04	0 - 1	<5.7	17 J	200 J	<28	<1.1	<11 U	<5.7		<11	<1.1	<23	<1.7 UJ
SS-108 (05)	12/01/05	0 - 1	<4.9	14	200 J EB	R	<0.98	<9.8 U	<4.9		<9.8	<0.98	<20	<1.5
SS-13 (89)	10/26/89	0 - 1.5	<400	<19			<9	<9	<19		<22			<9
SS-2 (04)	11/23/04	0 - 1	<5	16 J	200	<25	<1	<10 U	<5		<10	<1	<20	<1.5 UJ
SS-3 (04)	11/08/04	0 - 1	<4.7	<9.4 U	150	<24	<0.94	<9.4	<4.7		<9.4	16	<19	1.6
WED-02 (99)	08/19/99	15 - 17	<450 UJ	<11	<11		<6	<6 UJ	<11		<6			<6
WS-109 (05)	12/01/05	0 - 1	R	89 J	1500 J EB	27 J	R	R	R		R	15 J	R	R
WS-112 (05)	11/29/05	0 - 1	3.2 J	82	520 EB	R	<2.5	<25 U	13		<25	R	12 J	6.6 J
WS-113 (05)	11/29/05	0 - 1	R	230 J	740 J EB	25 J	R	R	R		R	R	R	8.2 J
WS-4 (04)	11/08/04	0 - 1	<7.5 UJ	<15 U	45 J	<37	<1.5	<15	<7.5		<15	<1.5 UJ	<30	<2.2
SS-01 (00)	09/27/00	0 - 6	<350	0 R	<510 UJ		<510	<510	<510	<510	<540 UJ			<510
SS-02 (00)	09/27/00	6 - 12	<370	0 R	<480 UJ		<480	<480	<480	<480	<530 UJ			<480
SS-03 (00)	09/27/00	4 - 8	<350	0 R	<500 UJ		<500	<500	<500	<500	<530 UJ			<500
SS-03 (99)	08/04/99	0 - 0.5	<330	<11 UJ	<11 UJ		<6 UJ	<6 UJ	<11 UJ		<6 UJ			<6 UJ
SS-04 (00)	09/27/00	4 - 8	<350	0 R	<460 UJ		<460	<460	<460	<460	<520 UJ			<460
SS-05 (00)	09/27/00	1.5 - 2	<370	0 R	<470 UJ		<470	<470	<470	<470	<520 UJ			<470
SS-05 (99)	08/04/99	0.5 - 2	<350	<11 UJ	<11 UJ		<5	<5	<11		<5			<5
SS-06 (00)	09/27/00	1.5 - 2	<370	0 R	<780 UJ		<780	<780	<780	<780	<950 UJ			<780
SS-07 (00)	09/27/00	1.5 - 2	<350	0 R	<610 UJ		<510	<510	<510	<510	<510 UJ			<510
SS-08 (00)	10/25/00	0 - 0.25	<550	<550 UJ	<550 UJ		<550	<550	<550	220 J	<550			<550
SS-08 (99)	08/04/99	0 - 0.5	<350	<13 UJ	<89 UJ		<6 UJ	<6 UJ	<13 UJ		<6 UJ			2 J
SS-09 (00)	10/25/00	0 - 0.25	<560	<560 UJ	<560 UJ		<560	<560	<560	270 J	<560			<560
SS-09 (99)	08/04/99	0.5 - 2	<690	<23 UJ	<23 UJ		<12	<12	<23		<12			1.2 J
SS-10 (00)	10/25/00	0 - 0.25	<1100	<1100	<1100		<1100	<1100	<1100	1800	<1100			<1100
SS-10 (99)	08/04/99	0.5 - 2	<570	<19 UJ	<19 UJ		<10 UJ	<10 UJ	<19 UJ		<10 UJ			<10 UJ
SS-11 (00)	10/25/00	0 - 0.25	<500	<500 UJ	<500 UJ		<500	<500	<500	310 J	<500			<500
SS-11 (99)	08/04/99	0 - 0.5	<350	<1200	<1200 UJ		<1200	<1200	<1200		60 J			<1200
SS-110 (05)	11/29/05	0 - 1	R	28 J	240 J EB	6.8 J	<1.2	<12 U	<6		<12	R	<24 UJ	<1.8 UJ
SS-12 (00)	10/25/00	0 - 0.25	<930	<930 UJ	<930 UJ		<930	<930	<930	760 J	<930			<930
SS-12 (89)	10/26/89	0 - 0.67	<390	<19	<19		<9	<9	<19		<9			<9
SS-12 (99)	08/04/99	0 - 0.5	<390	<10	120 J		<5	<5	<10		<5			<5 UJ
SS-13 (99)	08/04/99	0 - 0.5	<370	<11 UJ	72		1 J	<6	<11		<9			1 J
SS-14 (99)	08/04/99	0 - 0.5	<360	<10 UJ	100 J		<5 UJ	<5 UJ	<10 UJ		<5 UJ			<5 UJ
SS-15 (99)	08/04/99	0.5 - 2	<1500	<12 UJ	40 J		<6 UJ	<6 UJ	<12 UJ		<6 UJ			1 J
SS-16 (99)	08/04/99	0 - 0.5	<380	<12 UJ	170 J		<6 UJ	<6 UJ	<12 UJ		<6 UJ			0.7 J
SS-17 (99)	08/04/99	1.5 - 2	<340	<12 UJ	61		<6 UJ	2 J	<12		<9			1 J
WS-111 (05)	12/01/05	0 - 1	R	32	280 EB	R	<2.2	<160 U	<11		<22	R	<44	<3.3 UJ

NOTE:

ug/kg = micrograms per kilogram.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

J = estimated concentration.

UJ = estimated reporting limit.

U = Laboratory result qualified as less than indicated limit based on blank contamination.

R = result rejected upon validation.

Table 5-6d

Concentrations of SVOCs in Soil (ug/kg)
Reference Locations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Anthracene	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(ghi) perylene	Benzo(k) fluoranthene	Benzoic Acid	Bis(2-Ethylhexyl) phthalate	Butyl benzyl phthalate	Caprolactam	Carbazole	Chrysene
SD-08 (99)	08/10/99	0 - 0.5	<350	<350	<350	<350	<350	<350		<350	<350		<350	<350
SS-01 (99)	08/04/99	0 - 0.5	<460	<460	<460	27 J	<460	<460		<460	<460		<460	25 J
SS-1 (04)	11/23/04	0 - 1	<430	<430	<430	<430	<430	<430	580 J	<860	<430		<430	<430
SS-108 (05)	12/01/05	0 - 1	<410	<410	<410	<410	<410	<410	770 J	<810	<410		<410	<410
SS-13 (89)	10/26/89	0 - 1.5	<400	<400	<400 UJ	<400 UJ	<400 UJ	<400 UJ	<1900	<400	<400			<400
SS-2 (04)	11/23/04	0 - 1	<410	<410	<410	<410	<410	<410	600 J	<820	<410		<410	<410
SS-3 (04)	11/08/04	0 - 1	<400	<400	<400	<400	<400	<400	890 J	200 J	<400		<400	<400
WED-02 (99)	08/19/99	15 - 17	<450 UJ	<450 UJ	<450 UJ	<450 UJ	<450 UJ	<450 UJ		<450 UJ	<450 UJ		<450 UJ	<450 UJ
WS-109 (05)	12/01/05	0 - 1	<2400 R	<2400 R	<2400 R	<2400 R	<2400 R	<2400 R	5800 J	<4800	<2400 R		<2400 R	<2400 R
WS-112 (05)	11/29/05	0 - 1	<900	<900	<900	<900	<900	<900	<9000	<1800	<900		<900	<900
WS-113 (05)	11/29/05	0 - 1	<1300 R	<1300 R	<1300 R	<1300 R	<1300 R	<1300 R	<13000 R	<2700	<1300 R		<1300 R	<1300 R
WS-4 (04)	11/08/04	0 - 1	<670	<670	<670	<670	<670	<670	<6700	<1300	<670		<670	<670
SS-01 (00)	09/27/00	0 - 6	<350	<350	<350	<350	<350	<350		<350 UJ	<350 UJ		<350	<350
SS-02 (00)	09/27/00	6 - 12	<370	<370	<370	<370	<370	<370		<370 UJ	<370 UJ		<370	<370
SS-03 (00)	09/27/00	4 - 8	<350	<350	<350	<350	<350	<350		<350 UJ	<350 UJ		<350	<350
SS-03 (99)	08/04/99	0 - 0.5	<330	<330	<330	<330	<330	<330		<330	<330		<330	<330
SS-04 (00)	09/27/00	4 - 8	<350	<350	<350	<350	<350	<350		<350 UJ	<350 UJ		<350	<350
SS-05 (00)	09/27/00	1.5 - 2	<370	<370	<370	<370	<370	<370		<370 UJ	<370 UJ		<370	<370
SS-05 (99)	08/04/99	0.5 - 2	<350	<350	<350	<350	<350	<350		<350	<350		<350	<350
SS-06 (00)	09/27/00	1.5 - 2	<370	<370	<370	<370	<370	<370		<370 UJ	<370 UJ		<370	<370
SS-07 (00)	09/27/00	1.5 - 2	<350	<350	<350	<350	<350	<350		<350 UJ	<350 UJ		<350	<350
SS-08 (00)	10/25/00	0 - 0.25	<380	62 J	64 J	68 J	<380	60 J		110 J	<380	<380	<380	90 J
SS-08 (99)	08/04/99	0 - 0.5	<350	<350	<350	<350	<350	<350		<350	<350		<350	<350
SS-09 (00)	10/25/00	0 - 0.25	<380	<380	<380	<380	<380	<380		140 J	<380	51 J	<380	<380
SS-09 (99)	08/04/99	0.5 - 2	<690	<690	<690	<690	<690	<690		<690	<690		<690	<690
SS-10 (00)	10/25/00	0 - 0.25	<2500	<2500	<2500	<2500	<2500	<2500		<2500	<2500	<2500	<2500	310 J
SS-10 (99)	08/04/99	0.5 - 2	<570	<570	<570	<570	<570	<570		<570	<570		<570	<570
SS-11 (00)	10/25/00	0 - 0.25	<1900	390 J	390 J	400 J	200 J	320 J		200 J	<1900	<1900	<1900	560 J
SS-11 (99)	08/04/99	0 - 0.5	<350	<350	<350	28 J	<350	<350		<350	<350		<350	21 J
SS-110 (05)	11/29/05	0 - 1	<500	<500	<500	<500	<500	<500	1100 J	<1000	<500		<500	87 J
SS-12 (00)	10/25/00	0 - 0.25	<2300	430 J	400 J	450 J	<2300	340 J		<2300	<2300	<2300	<2300	620 J
SS-12 (89)	10/26/89	0 - 0.67	<390	<390	<390	<390	<390	<390	93 J	<390	<390			<390
SS-12 (99)	08/04/99	0 - 0.5	390 J	33 J	37 J	56 J	35 J	21 J		<390	<390		<390	43 J
SS-13 (99)	08/04/99	0 - 0.5	33 J	110 J	110 J	170 J	99 J	35 J		<780	110 J		22 J	130 J
SS-14 (99)	08/04/99	0 - 0.5	<360	<360	<360	<360	<360	<360		<360	<360		<360	<360
SS-15 (99)	08/04/99	0.5 - 2	<1500	<1500	<1500	<1500	<1500	<1500		<1500	<1500		<1500	<1500
SS-16 (99)	08/04/99	0 - 0.5	21 J	99 J	93 J	140 J	90 J	30 J		<380	<380		<380	100 J
SS-17 (99)	08/04/99	1.5 - 2	<340	<340	18 J	27 J	19 J	<340		<340	<340		<340	22 J
WS-111 (05)	12/01/05	0 - 1	<740 UJ	<740	<740	<740	<740	<740	<7400	<1500	<740		<740	<740

NOTE:

ug/kg = micrograms per kilogram.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

J = estimated concentration.

UJ = estimated reporting limit.

R = result rejected upon validation.

Table 5-6d

Concentrations of SVOCs in Soil (ug/kg)
Reference Locations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Dibenzo(a,h) anthracene	Diethyl phthalate	Di-n-butyl phthalate	Fluor anthene	Fluorene	Indeno (1,2,3-cd) Pyrene	Phen anthrene	Phenol	Pyrene
SD-08 (99)	08/10/99	0 - 0.5	<350	<350	<350	<350	<350	<350	<350	<350	<350
SS-01 (99)	08/04/99	0 - 0.5	<460	<460	24 J	44 J	<460	<460	28 J	66 J EB	47 J
SS-1 (04)	11/23/04	0 - 1	<430	<430	<430	<430	<430	<430	<430	<610	<430
SS-108 (05)	12/01/05	0 - 1	<410	<410	<410	<410	<410	<410	<410	<570	<410
SS-13 (89)	10/26/89	0 - 1.5	<400 UJ	<400	<400	<400	<400	<400 UJ	<400	<400	<400
SS-2 (04)	11/23/04	0 - 1	<410	<410	<410	<410	<410	<410	<410	<580	<410
SS-3 (04)	11/08/04	0 - 1	<400	<400	<400	<400	<400	<400	<400	<560	<400
WED-02 (99)	08/19/99	15 - 17	<450 UJ	<450 UJ	<450 UJ	<450 UJ	<450 UJ	<450 UJ	<450 UJ	<450 UJ	<450 UJ
WS-109 (05)	12/01/05	0 - 1	<2400 R	<2400 R	<2400 R	<2400 R	<2400 R	<2400 R	<2400 R	<3300 R	<2400 R
WS-112 (05)	11/29/05	0 - 1	<900	<900 U	<900	<900	<900	<900	<900	<1300	<900
WS-113 (05)	11/29/05	0 - 1	<1300 R	390 R	<1300 R	<1300 R	<1300 R	<1300 R	<1300 R	<1900 R	<1300 R
WS-4 (04)	11/08/04	0 - 1	<670	<670	<670	<670	<670	<670	<670	<930	<670
SS-01 (00)	09/27/00	0 - 6	<350	<350	<350	<350	<350	<350	<350	<350 UJ	<350
SS-02 (00)	09/27/00	6 - 12	<370	<370	<370	<370	<370	<370	<370	<370 UJ	<370
SS-03 (00)	09/27/00	4 - 8	<350	<350	<350	<350	<350	<350	<350	<350 UJ	<350
SS-03 (99)	08/04/99	0 - 0.5	<330	<330	19 J	<330	<330	<330	<330	27 J EB	<330
SS-04 (00)	09/27/00	4 - 8	<350	<350	<350	<350	<350	<350	<350	<350 UJ	<350
SS-05 (00)	09/27/00	1.5 - 2	<370	<370	<370	<370	<370	<370	<370	<370 UJ	<370
SS-05 (99)	08/04/99	0.5 - 2	<350	<350	<350	<350	<350	<350	<350	27 J EB	<350
SS-06 (00)	09/27/00	1.5 - 2	<370	<370	<370	<370	<370	<370	<370	<370 UJ	<370
SS-07 (00)	09/27/00	1.5 - 2	<350	<350	<350	<350	<350	<350	<350	<350 UJ	<350
SS-08 (00)	10/25/00	0 - 0.25	<380	<380	43 J	140 J	<380	47 J	50 J	<380	130 J
SS-08 (99)	08/04/99	0 - 0.5	<350	<350	<350	21 J	<350	<350	<350	38 J EB	21 J
SS-09 (00)	10/25/00	0 - 0.25	<380	<380	<380 UJ	48 J	<380	<380	<380	<380	41 J
SS-09 (99)	08/04/99	0.5 - 2	<690	<690	<690	<690	<690	<690	<690	85 J EB	<690
SS-10 (00)	10/25/00	0 - 0.25	<2500	<2500	<2500 UJ	490 J	<2500	<2500	<2500	<2500	400 J
SS-10 (99)	08/04/99	0.5 - 2	<570	<570	<570	<570	<570	<570	<570	78 J EB	<570
SS-11 (00)	10/25/00	0 - 0.25	<1900	<1900	<1900 UJ	910 J	<1900	250 J	420 J	<1900	760 J
SS-11 (99)	08/04/99	0 - 0.5	<350	<350	<350	36 J	<350	<350	20 J	69 J EB	38 J
SS-110 (05)	11/29/05	0 - 1	<500	<500	<500	120 J	<500	<500	86 J	<700	100 J
SS-12 (00)	10/25/00	0 - 0.25	<2300	<2300	<2300 UJ	1000 J	<2300	250 J	440 J	<2300	820 J
SS-12 (89)	10/26/89	0 - 0.67	<390	<390	<390	<390	<390	<390	<390	<390	<390
SS-12 (99)	08/04/99	0 - 0.5	<390	<390	<390	78 J	<390	28 J	28 J	36 J EB	71 J
SS-13 (99)	08/04/99	0 - 0.5	19 J	<370	<370	320 J	19 J	77 J	230 J	34 J EB	290 J
SS-14 (99)	08/04/99	0 - 0.5	<360	<360	<360	<360	<360	<360	<360	<360	<360
SS-15 (99)	08/04/99	0.5 - 2	<1500	<1500	<1500	<1500	<1500	<1500	<1500	<1500	<1500
SS-16 (99)	08/04/99	0 - 0.5	<380	<380	<380	210 J	<380	74 J	120 J	<380	220 J
SS-17 (99)	08/04/99	1.5 - 2	<340	<340	<340	38 J	<340	<340	27 J	<340	36 J
WS-111 (05)	12/01/05	0 - 1	<740	<740 U	<740	<740	<740	<740	<740	<1000	<740
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. J = estimated concentration. UJ = estimated reporting limit. R = result rejected upon validation.											

Table 5-6e

Concentrations of Metals in Soil (mg/kg)
Reference Locations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Aluminum, Total	Antimony, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Cyanide, Total
PMW-4 (02)	05/28/02	0 - 2			<5								
PMW-5 (02)	05/28/02	0 - 2			<5								
PMW-6 (02)	05/28/02	0 - 4			<5								
SD-08 (99)	08/10/99	0 - 0.5	3750	<0.57 UJ	3.6 J	9.1	<0.13 UJ	<0.08	408	6.2 J	1.3	3.7 J	<0.38
SD-09 (99)	08/10/99	0 - 0.5	4580	<0.6	2.6 J	13	<0.22 UJ	<0.09	462	7.6 J	1.8	3.3 J	
SS-01 (99)	08/04/99	0 - 0.5	7660 J	R	<4.3 UJ	12.4 J	0.3 J	<0.14 UJ	<3.5 UJ	6.8 J	0.71 J	7.1 J	0.09 J
SS-02 (99)	08/04/99	0 - 0.5	8010 J	R	<4.4 UJ	12.1 J	0.36 J	<0.14 UJ	<3.5 UJ	6.9 J	<0.6 UJ	6.4 J	
SS-1 (04)	11/23/04	0 - 1	8100	<2.6	3.8	8.3	<0.26	0.08 J	100	7	1.1	1.6	
SS-108 (05)	12/01/05	0 - 1	4500	<2.4 UJ	3 J	5.1	<0.24	<0.24 UJ	54	3.7	0.64 J	1.8	
SS-13 (89)	10/26/89	0 - 1.5	5550	<9.17	11.4 J	6.2	<0.24	<1.13	263 J	8	3.5 J	2.4 J	
SS-2 (04)	11/23/04	0 - 1	9000	<2.5	4.6	7.6	<0.25	0.082 J	90	9.2	2	3	
SS-3 (04)	11/08/04	0 - 1	6200	<2.4	4.4 J	12	0.037 J	<0.24 UJ	55	5.6	1	3.7	
WED-02 (99)	08/19/99	15 - 17	7070	<0.77 UJ	4.6	39.1	0.28	<0.13	1600 J	19.6	5.5	13	0.09 J
WS-109 (05)	12/01/05	0 - 1	2100 J	1.2 J	3.2 J	70 J	0.76 J	0.33 J	8400 J	2.4 J	1.5 J	11 J	
WS-112 (05)	11/29/05	0 - 1	5400	<5.4 UJ	2.5 J	20	0.52 J	0.16 J	2200	7.2	1 J	5.4	
WS-113 (05)	11/29/05	0 - 1	8500 J	R	12 J	45 J	1.9 J	0.49 J	6400 J	9 J	2.4 J	11 J	
WS-4 (04)	11/08/04	0 - 1	4000	<3.9	2.2 J	2.7	<0.39	<0.39	41	5.2	0.27 J	0.78 J	
SS-01 (00)	09/27/00	0 - 6	5080	<0.51 UJ	<5.1	10.4	0.24 J	<0.05	673	7.7	2.9 J	6.2	<0.02 UJ
SS-02 (00)	09/27/00	6 - 12	4100	<0.51 UJ	6.6	13.2	0.32 J	<0.05	584	10.3	3.4 J	4	<0.02 UJ
SS-03 (00)	09/27/00	4 - 8	3020	<0.5 UJ	<4.2	8.3	0.16 J	<0.05	465	7.1	2.1 J	2.4 J	<0.02 UJ
SS-03 (99)	08/04/99	0 - 0.5	3720 J	R	<3.4 UJ	8.6 J	0.22 J	<0.1 UJ	296 J	6.7 J	2.5 J	4.2 J	<0.05 UJ
SS-04 (00)	09/27/00	4 - 8	3130	<0.49 UJ	<3.7	7.5	<0.14	<0.05	409	6.2	2.8 J	3	<0.02 UJ
SS-05 (00)	09/27/00	1.5 - 2	7020	<0.54 UJ	6.2	6.8	0.35 J	<0.05	293	8.9	3.4 J	2.8 J	<0.02 UJ
SS-05 (99)	08/04/99	0.5 - 2	3740 J	R	4.6 J	7.6 J	0.26 J	<0.11 UJ	237 J	6.3 J	3.4 J	13.1 J	<0.05 UJ
SS-06 (00)	09/27/00	1.5 - 2	8700	<0.52 UJ	<4.6	10.4	0.33 J	<0.05	290	10	2.5 J	2.8 J	<0.02 UJ
SS-07 (00)	09/27/00	1.5 - 2	6810	<0.52 UJ	7.6	8.3	0.33 J	<0.05	550	8.5	3.2 J	4.2	<0.03 UJ
SS-08 (00)	10/25/00	0 - 0.25	6030	<0.99 UJ	8.7	39.8	0.28 J	<0.06	2510 J	8.2	<2.4 UJ	30.8	0.26 J
SS-08 (99)	08/04/99	0 - 0.5	8910 J	R	6.1 J	16.1 J	0.36 J	<0.11 UJ	<2.7 UJ	10.4 J	2.4 J	6.1 J	0.18 J
SS-09 (00)	10/25/00	0 - 0.25	5560	<0.57 UJ	5 J	<0.79	0.33	<0.05	1500 J	8.5	<2.2 UJ	9.3	<0.02 UJ
SS-09 (99)	08/04/99	0.5 - 2	7460 J	R	<5.4 UJ	18.2 J	0.41 J	<0.19 UJ	407 J	12.2 J	1.1 J	2.7 J	0.45 J
SS-10 (00)	10/25/00	0 - 0.25	3260	<1.2 UJ	2.5 J	42.4	<0.21	<0.07	4250 J	13.8	<2 UJ	19.7	0.33 J
SS-10 (99)	08/04/99	0.5 - 2	8420 J	R	<2 UJ	10.3 J	1.3 J	<0.17 UJ	<4.4 UJ	6.6 J	<0.77 UJ	1.6 J	0.16 J
SS-11 (00)	10/25/00	0 - 0.25	7740	<0.51 UJ	7.1	32.7	0.33	<0.05	1300 J	15.1	<3.2 UJ	14.5	<0.08 UJ
SS-11 (99)	08/04/99	0 - 0.5	7160 J	R	4.7 J	11.6 J	0.27 J	<0.11 UJ	<2.7 UJ	9 J	1.9 J	5.2 J	<0.05 UJ
SS-110 (05)	11/29/05	0 - 1	3400	0.28 J	6.2 J	8.7	<0.29	0.045 J	67	4.1	0.77 J	4.4	
SS-12 (00)	10/25/00	0 - 0.25	5120	<0.61 UJ	6.5	41.1	0.21 J	<0.06	2450 J	9.8	<2 UJ	27.8	0.64 J
SS-12 (89)	10/26/89	0 - 0.67	5580	<8.6	10.7	9	<0.3	<1.13	154 J	7	1.5 J	3.1 J	
SS-12 (99)	08/04/99	0 - 0.5	7780 J	<0.7 UJ	24.8 J	22.3 J	0.33 J	0.35 J	2450 J	12.1 J	2.1 J	30.2 J	0.53 J
SS-13 (99)	08/04/99	0 - 0.5	6680 J	<0.68 UJ	6.1 J	14.9 J	0.24 J	<0.11 UJ	<86.9 UJ	10.7 J	2.3 J	13.4 J	0.21 J
SS-14 (99)	08/04/99	0 - 0.5	4670 J	<0.66 UJ	6 J	18.5 J	0.23 J	<0.11 UJ	1060 J	12.7 J	2.6 J	9.5 J	0.88 J
SS-15 (99)	08/04/99	0.5 - 2	5230 J	<0.68 UJ	5.8 J	15.1 J	0.19 J	<0.11 UJ	586 J	10.2 J	2.6 J	14.2 J	0.12 J
SS-16 (99)	08/04/99	0 - 0.5	5210 J	<0.68 UJ	14.2 J	25.6 J	0.19 J	0.15 J	1550 J	12.4 J	2.9 J	69.8 J	0.37 J
SS-17 (99)	08/04/99	1.5 - 2	4990 J	<0.61 UJ	9 J	17.4 J	0.24 J	<0.1 UJ	896 J	9 J	2.3 J	24.2 J	0.1 J
WS-111 (05)	12/01/05	0 - 1	2400	0.49 J	35 J	11	0.4 J	0.056 J	2100	4.2	1.4 J	2.9	

NOTE:
ug/kg = micrograms per kilogram.
ft = feet below ground surface.
< = less than minimum reporting limit as indicated by the laboratory.
Bold indicates a concentration detected above the reporting limit.
J = estimated concentration.
UJ = estimated reporting limit.
R = result rejected upon validation.

Table 5-6e

Concentrations of Metals in Soil (mg/kg)
Reference Locations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Selenium, Total	Silver, Total	Sodium, Total	Vanadium, Total	Zinc, Total
PMW-4 (02)	05/28/02	0 - 2												
PMW-5 (02)	05/28/02	0 - 2												
PMW-6 (02)	05/28/02	0 - 4												
SD-08 (99)	08/10/99	0 - 0.5	4480 J	3.5	1080	44.7	<0.05	5.7 J	494	<0.51 UJ	<0.2	252	6.3	10.6
SD-09 (99)	08/10/99	0 - 0.5	4360 J	3.7	1400	49.9	<0.04	6.7 J	572	<0.62 UJ	<0.22	328	7	12.7
SS-01 (99)	08/04/99	0 - 0.5	5830 J	39.7 J	445 J	18.2 J	<0.07 UJ	3.1 J	<222 UJ	<1.1 UJ	<3.9 UJ	<217 UJ	10.6 J	12.5 J
SS-02 (99)	08/04/99	0 - 0.5	5670 J	28.9 J	490 J	25 J	<0.07 UJ	3 J	<233 UJ	<1.4 UJ	<0.38 UJ	<270 UJ	11.7 J	10.7 J
SS-1 (04)	11/23/04	0 - 1	5900	14	400	16	0.032 J	3.2	110 J	0.72	<0.52	<100	9.3	8.2
SS-108 (05)	12/01/05	0 - 1	4200	11 J	81	9.8	0.037 J	1.6	50 J	0.37 J	<0.068 U	<96	8.7	<6.4 U
SS-13 (89)	10/26/89	0 - 1.5	4200	1.4	1160	45.9 J	<0.12	<6.27	263.8	<0.48 UJ	R	<19.54	7.1	<10.3
SS-2 (04)	11/23/04	0 - 1	6300	18	780	33	0.019 J	6.1	180	0.72	<0.49	<98	10	9.8
SS-3 (04)	11/08/04	0 - 1	4700	16	230	20	0.032 J	3.3	87 J	0.55	<0.47	<95	11	8.7
WED-02 (99)	08/19/99	15 - 17	11300	6.3	3320 J	140	<0.06	15.2	2220	0.85 J	0.4 J	249	18.2	30.1
WS-109 (05)	12/01/05	0 - 1	1400 J	220 J	1000 J	12 J	0.24 J	4.8 J	240 J	2.5 J	R	370 J	14 J	R
WS-112 (05)	11/29/05	0 - 1	1400	17 J	250	16	0.067 J	3.1	75 J	<1.1	<1.1	200 J	3.6	<22
WS-113 (05)	11/29/05	0 - 1	4700 J	51 J	550 J	160 J	0.13 J	7 J	87 R	1.7 J	<1.6 R	850 J	6.7 J	60 J
WS-4 (04)	11/08/04	0 - 1	270	5.9	48	1.9	0.048 J	0.9 J	36 J	0.47 J	<0.64 U	<160	2.2	6.3
SS-01 (00)	09/27/00	0 - 6	5100	8.2	1150	75.4	<0.04 UJ	6.6	334	<0.54	<1	<36	8.3	<15.7
SS-02 (00)	09/27/00	6 - 12	5270	2.8	1430	97.9	<0.03 UJ	6.9	560	<0.54	<1	<53.2	7.7	<11
SS-03 (00)	09/27/00	4 - 8	4110	2.2	1110	94.5	<0.03 UJ	6.2	394	<0.54	<1	<41.6	6.6	<9
SS-03 (99)	08/04/99	0 - 0.5	3920 J	4.2 J	1140 J	96.2 J	<0.05 UJ	5.9 J	524 J	<0.64 UJ	<0.28 UJ	<266 UJ	6 J	12.5 J
SS-04 (00)	09/27/00	4 - 8	4050	2.4	1050	109	<0.03 UJ	6.7	433	<0.53	<0.99	<33.4	6.4	<9.7
SS-05 (00)	09/27/00	1.5 - 2	5660	3.7	1200	49	<0.04 UJ	6.1	311	<0.59	<1.1	<32	9.6	<16.6
SS-05 (99)	08/04/99	0.5 - 2	4150 J	<2.8 UJ	1110 J	98.8 J	<0.05	6.5 J	471 J	<0.49 UJ	<0.3 UJ	<233 UJ	5.8 J	13.3 J
SS-06 (00)	09/27/00	1.5 - 2	6480	5.5	1080	67.7	<0.04 UJ	5.5	224	<0.56	<1	<34.9	9.5	<12.6
SS-07 (00)	09/27/00	1.5 - 2	6340	8.6	1150	81.1	<0.04 UJ	6.8	302	<0.56	<1	<42.6	9.4	<23.6
SS-08 (00)	10/25/00	0 - 0.25	6350	72.7	1230 J	102	<0.03 UJ	4.7 J	464	<0.64	2.4	<64.7	8.8	0.9 J
SS-08 (99)	08/04/99	0 - 0.5	7480 J	14.3 J	1390 J	75.7 J	<0.05 UJ	7.4 J	487 J	<1.1 UJ	0.46 J	<281 UJ	12.1 J	17 J
SS-09 (00)	10/25/00	0 - 0.25	4850	21.8	1410 J	98.5	<0.04 UJ	5.9 J	342	<0.61	1.6 J	<75.6	8.4	26.2 J
SS-09 (99)	08/04/99	0.5 - 2	4740 J	7.2 J	867 J	25.3 J	<0.1 UJ	7.1 J	<272 UJ	<1.4 UJ	<0.53 UJ	<512 UJ	7 J	<8.7 UJ
SS-10 (00)	10/25/00	0 - 0.25	6320	97.3	752 J	202	0.06 J	<2.7 UJ	544	<0.82	2.8 J	<82.7	5.9	70.1 J
SS-10 (99)	08/04/99	0.5 - 2	1420 J	<5.6 UJ	528 J	15.4 J	<0.09 UJ	3.8 J	<180 UJ	<1.1 UJ	<0.49 UJ	<313 UJ	3.9 J	<7.5 UJ
SS-11 (00)	10/25/00	0 - 0.25	8050	65.6	1580 J	137	<0.04 UJ	6.4 J	422	<0.55	2.2	<90	13.8	43.4 J
SS-11 (99)	08/04/99	0 - 0.5	6140 J	15 J	1050 J	79.5 J	<0.05 UJ	6.2 J	389 J	<1.2 UJ	0.46 J	<264 UJ	11.4 J	13.3 J
SS-110 (05)	11/29/05	0 - 1	4600	49 J	220	8.4	0.073 J	2.6	83 J	0.75	<0.068 U	<120	8.1	14
SS-12 (00)	10/25/00	0 - 0.25	5920	48	1160 J	174	0.04 J	5.3 J	486	<0.66	1.7 J	<97	10.1	77 J
SS-12 (89)	10/26/89	0 - 0.67	4799	8.1	765	59.1 J	<0.11	<5.58	<207.89	<0.54 UJ	R	<18.33	9.3	<1.3
SS-12 (99)	08/04/99	0 - 0.5	7040 J	34 J	1400 J	91.8 J	<0.06 UJ	7.4 J	419 J	0.85 J	0.35 J	<259 UJ	10.6 J	34.3 J
SS-13 (99)	08/04/99	0 - 0.5	6360 J	40.2 J	1190 J	75.4 J	<0.06 UJ	8.3 J	391 J	<0.52 UJ	<0.32 UJ	<321 UJ	11 J	32.2 J
SS-14 (99)	08/04/99	0 - 0.5	6310 J	16.1 J	2170 J	114 J	<0.06 UJ	9.8 J	773 J	0.56 J	0.31 J	<247 UJ	10.1 J	81.3 J
SS-15 (99)	08/04/99	0.5 - 2	5360 J	62.4 J	1470 J	61 J	<0.06 UJ	9 J	497 J	0.61 J	0.38 J	<250 UJ	12.1 J	33.6 J
SS-16 (99)	08/04/99	0 - 0.5	6980 J	51.1 J	1510 J	166 J	<0.06 UJ	8.4 J	612 J	0.67 J	0.46 J	<292 UJ	10.2 J	73.2 J
SS-17 (99)	08/04/99	1.5 - 2	5550 J	20.8 J	1410 J	87.1 J	<0.05 UJ	6.9 J	564 J	0.54 J	0.3 J	<252 UJ	8.7 J	30.3 J
WS-111 (05)	12/01/05	0 - 1	6300	63 J	330	14	0.054 J	3	47 UJ	0.96	<0.066 U	66 J	5.8	<12 U

NOTE:
ug/kg = micrograms per kilogram.
ft = feet below ground surface.
< = less than minimum reporting limit as indicated by the laboratory.
Bold indicates a concentration detected above the reporting limit.
J = estimated concentration.
UJ = estimated reporting limit.
R = result rejected upon validation.

Table 5-6f

Concentrations of PCBs/Pesticides in Soils (ug/kg)
Reference Locations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, MA

Sample Location Identifier	Sample Date	Depth (ft)	Aroclor 1254	Aroclor 1260	4,4'-DDD	4,4'-DDE	4,4'-DDT	Alpha-BHC	alpha-Chlordane	Beta-BHC	Dieldrin
SD-08 (99)	08/10/99	0 - 0.5	150	<35	<3.5	<3.5	<3.5	<1.8	<1.8	<1.8	R
SS-01 (99)	08/04/99	0 - 0.5	<46	<46	<4.6	1.6 J	0.94 J	<2.4	<2.4	<2.4	<4.6
SS-1 (04)	11/23/04	0 - 1	<43.3	<43.3	<17.3	<17.3	<17.3	<8.66		<8.66	<17.3
SS-108 (05)	12/01/05	0 - 1	<40.6	<40.6	<65	<65	<65	<32.5		<32.5	<65
SS-13 (89)	10/26/89	0 - 1.5	<190	<190	<19	<19	<19	<9.5	<95	<9.5	<19
SS-2 (04)	11/23/04	0 - 1	<41.2	<41.2	<16.5	<16.5	<16.5	<8.23		<8.23	<16.5
SS-3 (04)	11/08/04	0 - 1	<40.2	<40.2	<3.21	<3.21	<3.21	<1.61		<1.61	<3.21
WED-02 (99)	08/19/99	15 - 17	<44	<44	<4.4	<4.4	<4.4	<2.3	<2.3	<2.3	<4.4
WS-109 (05)	12/01/05	0 - 1	R	R	R	R	R	R		R	R
WS-112 (05)	11/29/05	0 - 1	<90.1	<90.1	<144	<144	<144	<72.1		<72.1	<144
WS-113 (05)	11/29/05	0 - 1	R	R	R	R	R	R		R	R
WS-4 (04)	11/08/04	0 - 1	<66.7	<66.7	<26.7	<26.7	<26.7	<13.3		<13.3	<26.7
SS-01 (00)	09/27/00	0 - 6	<35	<35	<3.5	4.3	5.9	<1.8	<1.8	<1.8	<3.5
SS-02 (00)	09/27/00	6 - 12	<37	<37	<3.7	<3.7	<3.7	<1.9	<1.9	<1.9	<3.7
SS-03 (00)	09/27/00	4 - 8	<35	<35	<3.5	<3.5	<3.5	<1.8	<1.8	<1.8	<3.5
SS-03 (99)	08/04/99	0 - 0.5	<34	<34	<3.4	0.38 J	0.38 J	<1.7	0.59 J	<1.7	<3.4
SS-04 (00)	09/27/00	4 - 8	<35	<35	<3.5	<3.5	<3.5	<1.8	<1.8	<1.8	<3.5
SS-05 (00)	09/27/00	1.5 - 2	<36	<36	<3.6	<3.6	<3.6	<1.9	8 J	<1.9	<3.6
SS-05 (99)	08/04/99	0.5 - 2	<35	<35	<3.5	<3.5	<3.5	<1.8	7.3 J	0.24 J	<3.5
SS-06 (00)	09/27/00	1.5 - 2	<38	<38	<3.8	<3.8	<19	<1.9	<1.9	<1.9	<3.8
SS-07 (00)	09/27/00	1.5 - 2	<360	<360	<36	<36	<36	<18	770	<18	<36
SS-08 (00)	10/25/00	0 - 0.25	<38	<38	<3.8	23	35 J	<2	<2	<2	<3.8
SS-08 (99)	08/04/99	0 - 0.5	<35	<35	2.2 J	16	20 J	<1.8	<1.8	<1.8	<3.5
SS-09 (00)	10/25/00	0 - 0.25	<38	<38	<3.8	15	31	<2	R	<2	<3.8
SS-09 (99)	08/04/99	0.5 - 2	<69	<69	<6.9	<6.9	<6.9	0.18 J	<3.5	<3.5	<6.9
SS-10 (00)	10/25/00	0 - 0.25	230 J	<51	<5.1	23	37	<2.6	<2.6	<2.6	<5.1
SS-10 (99)	08/04/99	0.5 - 2	<57	<57	<5.7	<5.7	<5.7	<2.9	<2.9	<2.9	<5.7
SS-11 (00)	10/25/00	0 - 0.25	<37	<37	<3.7	63	87	<1.9	52 J	3.9 J	<3.7
SS-11 (99)	08/04/99	0 - 0.5	<35	<35	R	8.2	11	<1.8	<1.8	<1.8	1.2 J
SS-110 (05)	11/29/05	0 - 1	<49.8	<49.8	<79.6	<79.6	<79.6	<39.8		<39.8	<79.6
SS-12 (00)	10/25/00	0 - 0.25	<46	<46	<46	74	110	<2.4	<24	<2.4	<4.6
SS-12 (89)	10/26/89	0 - 0.67	<180	<180	<18	<18	24	<9.2	<92	<9.2	<18
SS-12 (99)	08/04/99	0 - 0.5	<39	<39	0 R	36	110	<2	32	<2	6.2 J
SS-13 (99)	08/04/99	0 - 0.5	46	30 J	0 R	15	39 J	<1.9	<1.9	<1.9	<3.7
SS-14 (99)	08/04/99	0 - 0.5	<36	<36	0 R	16	41	<1.9	<1.9	<1.9	0.49 J
SS-15 (99)	08/04/99	0.5 - 2	16 J	37 J	25 J	10	28 J	<2	3.7 J	<2	<3.8
SS-16 (99)	08/04/99	0 - 0.5	30 J	32 J	3.9 J	5	10 J	2	<2	<2	<3.8
SS-17 (99)	08/04/99	1.5 - 2	<34	<34	<3.4	1 J	2.5 J	<1.7	<1.7	<1.7	<3.4
WS-111 (05)	12/01/05	0 - 1	<74.1	<74.1	<118	<118	<118	<59.2		<59.2	<118
NOTE: ug/kg = micrograms per kilogram. ft = feet below ground surface. < = less than minimum reporting limit as indicated by the laboratory. Bold indicates a concentration detected above the reporting limit. J = estimated concentration. R = result rejected upon validation.											

Table 5-6f

Concentrations of PCBs/Pesticides in Soils (ug/kg)
Reference Locations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, MA

Sample Location Identifier	Sample Date	Depth (ft)	Endosulfan sulfate	Endrin	Endrin aldehyde	gamma-Chlordane	Heptachlor	Heptachlor epoxide	Lindane	Methoxy chlor
SD-08 (99)	08/10/99	0 - 0.5	<3.5	2.1 J	<3.5	<1.8	<1.8	R	4.6	<18
SS-01 (99)	08/04/99	0 - 0.5	<4.6	<4.6	<4.6	<2.4	<2.4	<2.4	<2.4	<24
SS-1 (04)	11/23/04	0 - 1	<17.3	<17.3	<17.3		<8.66	<8.66	<8.66	<86.6
SS-108 (05)	12/01/05	0 - 1	<65	<65	<65		<32.5	<32.5	<32.5	<325
SS-13 (89)	10/26/89	0 - 1.5	<19	<19		<95	<9.5	<9.5	<9.5	<95
SS-2 (04)	11/23/04	0 - 1	<16.5	<16.5	<16.5		<8.23	<8.23	<8.23	<82.3
SS-3 (04)	11/08/04	0 - 1	<3.21	<3.21	<3.21		<1.61	<1.61	<1.61	<16.1
WED-02 (99)	08/19/99	15 - 17	<4.4	<4.4	<4.4	<2.3	<2.3	<2.3	<2.3	<23
WS-109 (05)	12/01/05	0 - 1	R	R	R		R	R	R	R
WS-112 (05)	11/29/05	0 - 1	<144	<144	<144		<72.1	<72.1	<72.1	<721
WS-113 (05)	11/29/05	0 - 1	R	R	R		R	R	R	R
WS-4 (04)	11/08/04	0 - 1	<26.7	<26.7	<26.7		<13.3	<13.3	<13.3	<133
SS-01 (00)	09/27/00	0 - 6	<3.5	<3.5	<3.5	<1.8	<1.8	<1.8	<1.8	<18
SS-02 (00)	09/27/00	6 - 12	<3.7	<3.7	<3.7	<1.9	<1.9	<1.9	<1.9	<19
SS-03 (00)	09/27/00	4 - 8	<3.5	<3.5	<3.5	<1.8	<1.8	<1.8	<1.8	<18
SS-03 (99)	08/04/99	0 - 0.5	<3.4	<3.4	<3.4	0.41 J	<1.7	<1.7	<1.7	<17
SS-04 (00)	09/27/00	4 - 8	<3.5	<3.5	<3.5	<1.8	<1.8	<1.8	<1.8	<18
SS-05 (00)	09/27/00	1.5 - 2	<3.6	<3.6	<3.6	7.7	<1.9	3.2 J	<1.9	<19
SS-05 (99)	08/04/99	0.5 - 2	<3.5	<3.5	<3.5	6.8 J	<1.8	<1.8	<1.8	<18
SS-06 (00)	09/27/00	1.5 - 2	<3.8	<3.8	<1.9	<190	<1.9	<1.9	<1.9	<3.8
SS-07 (00)	09/27/00	1.5 - 2	<36	<36	<36	790	130	110	<18	<180
SS-08 (00)	10/25/00	0 - 0.25	<3.8	<3.8	<3.8	<2	<2	<2	<2	<20
SS-08 (99)	08/04/99	0 - 0.5	0.38 J	<3.5	<3.5	0.68 J	<1.8	<1.8	<1.8	<18
SS-09 (00)	10/25/00	0 - 0.25	<3.8	<3.8	<3.8	2.7	<2	R	<2	<20
SS-09 (99)	08/04/99	0.5 - 2	<6.9	<6.9	<6.9	<3.5	<3.5	<3.5	<3.5	<35
SS-10 (00)	10/25/00	0 - 0.25	<5.1	<5.1	11 J	<2.6	<2.6	<2.6	<2.6	<26
SS-10 (99)	08/04/99	0.5 - 2	<5.7	<5.7	<5.7	<2.9	<2.9	<2.9	<2.9	<29
SS-11 (00)	10/25/00	0 - 0.25	<3.7	<3.7	<3.7	42	<1.9	<1.9	<1.9	<19
SS-11 (99)	08/04/99	0 - 0.5	<3.5	1.2 J	<3.5	1.4 J	<1.8	<1.8	<1.8	3.3 J
SS-110 (05)	11/29/05	0 - 1	<79.6	<79.6	<79.6		<39.8	<39.8	<39.8	<398
SS-12 (00)	10/25/00	0 - 0.25	<46	<4.6	<4.6	2.7 J	<2.4	<2.4	<2.4	<24
SS-12 (89)	10/26/89	0 - 0.67	<18	<18		<92	<9.2	<9.2	<9.2	<92
SS-12 (99)	08/04/99	0 - 0.5	4.5 J	R	0.69 J	14 J	<2	6	<2	<20
SS-13 (99)	08/04/99	0 - 0.5	<3.7	<3.7	1.2 J	R	<1.9	<1.9	R	<19
SS-14 (99)	08/04/99	0 - 0.5	<3.6	<3.6	<3.6	<1.9	<1.9	<1.9	<1.9	<19
SS-15 (99)	08/04/99	0.5 - 2	<3.8	<3.8	1.2 J	2.4 J	<2	<2	<2	<20
SS-16 (99)	08/04/99	0 - 0.5	<3.8	R	1.4 J	3.4 J	<2	1.3 J	<2	<20
SS-17 (99)	08/04/99	1.5 - 2	<3.4	<3.4	<3.4	<1.7	<1.7	<1.7	<1.7	<17
WS-111 (05)	12/01/05	0 - 1	<118	<118	<118		<59.2	<59.2	<59.2	<592

NOTE:
ug/kg = micrograms per kilogram.
ft = feet below ground surface.
< = less than minimum reporting limit as indicated by the laboratory.
Bold indicates a concentration detected above the reporting limit.
J = estimated concentration.
R = result rejected upon validation.

Table 5-6g

Concentrations of Metals in Groundwater (mg/l)
Reference Locations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Aluminum, Total	Antimony, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Cyanide, Total
MW-19B	11/15/04	59 - 69	0.63	<0.006	0.013	0.01	<0.002	<0.002	46	<0.01	<0.01	<0.01	
	03/14/01		0.555	<0.001	0.0089	0.114	<0.0005	<0.0001	269	<0.0025	<0.0025	<0.0025	
MW-19D	11/15/04	34 - 44	<0.1	<0.006	0.033	<0.01	<0.002	<0.002	6.3	<0.01	<0.01	<0.01	
	03/14/01		0.105	<0.001	0.0293	0.006 B	<0.0005	<0.0001	5.92	<0.0025	<0.0025	<0.0025	
MW-19S	11/15/04	10 - 20	<0.1	<0.006	<0.005	0.025	<0.002	<0.002	11	<0.01	<0.01	<0.01	
	03/14/01		0.0638	<0.001	<0.0025	0.0191	<0.0005	0.00011 B	8.92	<0.0025	<0.0025	<0.0025	
MW-23B	09/20/05	48 - 58	<0.096 U	<0.006	0.034	0.005 J	<0.002	<0.002	11	<0.01	<0.01	<0.01	
	12/08/04		1.2	<0.006	0.024	0.009 J	<0.002	<0.002	12	<0.01	<0.01	<0.01	
	12/14/05		<0.1	<0.006	0.036	0.004 J	<0.002	<0.002	12	<0.01	<0.01	<0.01	
PMW-4	06/04/02	2 - 10			0.2		0.005						
	06/13/02				<0.05		<0.004						
PMW-5	06/04/02	2 - 10			<0.05		<0.004						
PMW-6	09/20/05	2 - 10	420	<0.006	1.59	1.2	<0.002	0.0018 J	87	0.5	0.15	0.39	
	12/14/05		<0.1	<0.006	0.0035 J	0.04	<0.002	<0.002	73	<0.01	0.001 J	<0.01	
	06/04/02				<0.05		<0.004						
WEB-03	12/08/04	unknown	0.3	<0.006	0.016	0.02	<0.002	<0.002	13	0.002 J	<0.01	<0.01	
	09/13/99		1.27	<0.0022 UJ	0.0149	0.0258 J	<0.0001	<0.0004	25 J	0.0036	<0.0006 UJ	<0.0052	0.0012 J
WED-02	09/13/99	unknown	0.678	<0.0022 UJ	0.019	0.0155	<0.0001	<0.0004	16 J	0.0064	<0.0009 UJ	<0.002	<0.0009
	11/22/04		1.9	<0.006	0.0179	0.025	<0.002	<0.002	47	0.002 J	<0.01	<0.01	
WES-01	09/13/99	unknown	0.377	<0.0022 UJ	<0.0021	<0.001	<0.0001	<0.0004	6.11 J	<0.001	<0.0006 UJ	<0.002	<0.0009
	11/22/04		0.24	<0.006	<0.005	0.003 J	<0.002	<0.002	2.4	<0.01	<0.01	<0.01	
GP-26	11/11/04	2 - 12			<0.005		<0.002						
MW-24	12/14/05	3 - 13	0.4	<0.006	<0.005	0.01	<0.002	<0.002	4.9	<0.01	<0.01	<0.01	
	02/09/06		0.64	<0.006	<0.005	0.08	<0.002	<0.002	5.9	<0.01	<0.01	<0.01	
MW-24M	12/14/05	19.5 - 29.5	0.88	0.019	0.02	0.03	<0.002	<0.002	10	0.002 J	0.003 J	<0.01	
	02/09/06		<0.12 U	<0.006	<0.005	0.02	<0.002	<0.002	14	<0.01	<0.01	<0.01	
MW-25	12/13/05	10 - 20	0.65	<0.006	<0.005	0.07	0.0005 J	<0.002	9.9	<0.01	0.003 J	<0.01	
	02/09/06		1.6	<0.006	<0.005	0.15	<0.002	<0.002	15	<0.01	<0.01	<0.01	
MW-25M	12/14/05	23 - 33	<0.1	<0.006	<0.005	0.01	<0.002	<0.002	13	<0.01	0.001 J	<0.01	
	02/09/06		<0.1	<0.006	<0.005	0.03	<0.002	<0.002	23	<0.01	<0.01	<0.01	

NOTE:

mg/l = milligrams per liter.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

B = analyte also detected in a blank sample.

U = result qualified as non-detect due to blank contamination.

J = estimated concentration.

UJ = estimated reporting limit.

Table 5-6g

Concentrations of Metals in Groundwater (mg/l)
Reference Locations
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

Sample Location Identifier	Sample Date	Depth (ft)	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Sodium, Total	Thallium, Total	Vanadium, Total	Zinc, Total
MW-19B	11/15/04	59 - 69	1	<0.01	0.27	0.029	<0.0002	<0.025	2.6	9.6	<0.005	<0.01	<0.05
	03/14/01		0.0984	<0.0015	0.128	0.0102	<0.0002	<0.0025	8.64	14.1	<0.00005	<0.0025	<0.0025
MW-19D	11/15/04	34 - 44	2.1	<0.01	2	0.22	<0.0002	<0.025	<2.5	9.2	<0.005	<0.01	<0.05
	03/14/01		1.9	<0.0015	1.83	0.224	<0.0002	<0.0025	1.36	8.63	<0.00005	<0.0025	<0.0025
MW-19S	11/15/04	10 - 20	<0.05	<0.01	2.9	0.21	<0.0002	<0.025	<2.5	16	<0.005	<0.01	<0.05
	03/14/01		0.15	<0.0015	2.63	0.0233	<0.0002	<0.0025	0.684	11.2	0.00006 B	<0.0025	<0.0025
MW-23B	09/20/05	48 - 58	0.13	<0.01	2.3	0.08	<0.0002	<0.025	1.4 J	7.8	<0.005	<0.01	<0.05
	12/08/04		0.91	<0.01	2.4	0.07	<0.0002	<0.025	1.8 J	10 J	<0.005	0.002 J	0.05
	12/14/05		0.08	<0.01	2.3	0.1	<0.0002	<0.025	1.4 J	8.4	<0.005	<0.01	<0.05
PMW-4	06/04/02	2 - 10											
	06/13/02												
PMW-5	06/04/02	2 - 10											
PMW-6	09/20/05	2 - 10	340	0.296	81	4.5	0.00019 J	0.278	50	18	<0.005	0.47	0.53
	12/14/05		<0.05	<0.01	6.1	0.001 J	<0.0002	0.0018 J	7.9	10	<0.005	<0.001 U	<0.05
	06/04/02												
WEB-03	12/08/04	unknown	0.14	<0.01	0.94	0.007 J	<0.0002	<0.025	4.4 J	14	<0.005	0.001 J	0.008 J
	09/13/99		1.34	0.0023	1.59	0.029 J	<0.0001	<0.0021	10.7	20.2	<0.0021 UJ	0.0106	0.0226 J
WED-02	09/13/99	unknown	0.784	<0.001	2.32	0.0398 J	<0.0001	<0.0014	13.2	24	<0.002	0.0041	<0.0163
	11/22/04		0.95	<0.01	0.55	0.039	<0.00003 U	0.0021 J	3.3	8.2	<0.005	0.008 J	0.029 J
WES-01	09/13/99	unknown	<0.213	<0.001	0.537	0.019 J	<0.0001	<0.0007	1.56	8.17	<0.002	<0.0008	<0.0163
	11/22/04		0.12	<0.01	0.34	0.02	<0.00002 U	<0.025	0.24 J	4.7	<0.005	<0.01	<0.05
GP-26	11/11/04	2 - 12	3.4	0.0049 J	7.6	0.18							
MW-24	12/14/05	3 - 13	0.32	<0.01	0.77	0.09	<0.0002	0.003 J	1.6 J	4.7	<0.005	<0.01	<0.05
	02/09/06		<0.05	<0.01	1.7	0.09	<0.0002	<0.025	4.4	92	<0.005	<0.01	<0.05
MW-24M	12/14/05	19.5 - 29.5	0.92	<0.01	2	0.32	<0.0002	0.0065 J	7.1	69	<0.005	0.004 J	0.008 J
	02/09/06		0.56	<0.01	3.5	0.16	<0.0002	<0.025	5.6	50	<0.005	<0.01	<0.05
MW-25	12/13/05	10 - 20	0.014 J	<0.01	2	0.15	<0.0002	0.0051 J	8.6	64	<0.005	<0.01	0.007 J
	02/09/06		<0.05	<0.01	2.8	0.44	<0.0002	<0.025	14	180	<0.005	<0.01	<0.05
MW-25M	12/14/05	23 - 33	<0.05	<0.01	2.2	0.05	<0.0002	0.0023 J	2.6	98	<0.005	<0.01	<0.05
	02/09/06		<0.05	<0.01	3.8	0.14	<0.0002	<0.025	6	160	<0.005	<0.01	<0.05

NOTE:

mg/l = milligrams per liter.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated

Bold indicates a concentration detected above the minimum reporting limit

A blank space indicates the sample was not analyzed

B = analyte also detected in a blank sample.

U = result qualified as non-detect due to blank sample

J = estimated concentration.

UJ = estimated reporting limit.

Table 5-6h

Concentrations of VOCs and SVOCs in Groundwater (ug/l)
Reference Locations
Remedial Investigation and Feasibility Study
Suton Brook Disposal Area Superfund Site - Tewksbury, MA

Sample Location Identifier	Sample Date	Depth (ft)	VOCs						SVOCs	
			Acetone	Bromodichloromethane	Chloroform	Dibromochloromethane	Ethyl benzene	Xylenes (total)	Diethyl phthalate	Phenol
MW-19B	03/14/01	59 - 69	<5 UJ	<1	0.28 J	<1	<1	0.34 J	<6.1 UJ	1.8 J
	11/15/04		<5	<0.5	<0.75	<0.5	<0.5	<0.5	<5	<7
MW-19D	03/14/01	34 - 44	<5.2 UJ	<1	<1	<1	0.03 J	0.5 J	<5.8 UJ	<5.8 UJ
	11/15/04		<5	<0.5	<0.75	<0.5	<0.5	<0.5	<5	<7
MW-19S	03/14/01	10 - 20	<5 UJ	<1	<1	<1	<1	<0.5	<6 UJ	<6 UJ
	11/15/04		<5	<0.5	<0.75	<0.5	<0.5	<0.5	<5	<7
MW-23B	12/08/04	48 - 58	<5	<0.5	<0.75	<0.5	<0.5	<0.5	<5	<7
	09/20/05		<5	<0.5	<0.75	<0.5	<0.5	<0.5		
	12/14/05		<5	<0.5	<0.75	<0.5	<0.5	<0.5		
PMW-6	09/20/05	2 - 10	<5	<0.5	<0.75	<0.5	<0.5	<0.5		
	12/14/05		<5	<0.5	<0.75	<0.5	<0.5	<0.5		
WEB-03	09/13/99	unknown	<10 UJ	<10	<10	<10	<10	<10	0.8 J	220
	12/08/04								<5	<7
	01/05/05		<5	<0.5	<0.75	<0.5	<0.5	<0.5		
WED-02	09/13/99	unknown	10 J	<10	<10	<10	<10	<10	<10	<10
	11/22/04		<5	<0.5	<0.75	<0.5	<0.5	<0.5	<5	<7
WES-01	09/13/99	unknown	<10 UJ	<10	<10	<10	<10	<10	<10	<10
	11/22/04		<5 UJ	<0.5	<0.75	<0.5	<0.5	<0.5	<5	<7
GP-26	11/11/04	2 - 12	<5	<0.5	<0.75	<0.5	<0.5	<0.5		
MW-24	12/14/05	3 - 13	<5	<0.5	<0.75	<0.5	<0.5	<0.5		
	02/09/06		<5	<0.5	<0.75	<0.5	<0.5	<0.5		
MW-24M	12/14/05	19.5 - 29.5	<5	<0.5	<0.75 U	<0.5	<0.5	<0.5		
	02/09/06		<5	<0.5	<0.75	<0.5	<0.5	<0.5		
MW-25	12/13/05	10 - 20	<5	7.3	44	0.61	<0.5	<0.5		
	02/09/06		<5	2.4	13	<0.5	<0.5	<0.5		
MW-25M	12/14/05	23 - 33	<5	5.6	37	<0.5	<0.5	<0.5		
	02/09/06		<5	2.5	18	<0.5	<0.5	<0.5		

NOTE:

ug/l = micrograms per liter.

ft = feet below ground surface.

< = less than minimum reporting limit as indicated by the laboratory.

Bold indicates a concentration detected above the reporting limit.

A blank space indicates the sample was not analyzed for this constituent.

U = result qualified as non-detect due to blank contamination.

J = estimated concentration.

UJ = estimated reporting limit.

Table 5-6i

Summary of Existing Private Water Supply Well Samples
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

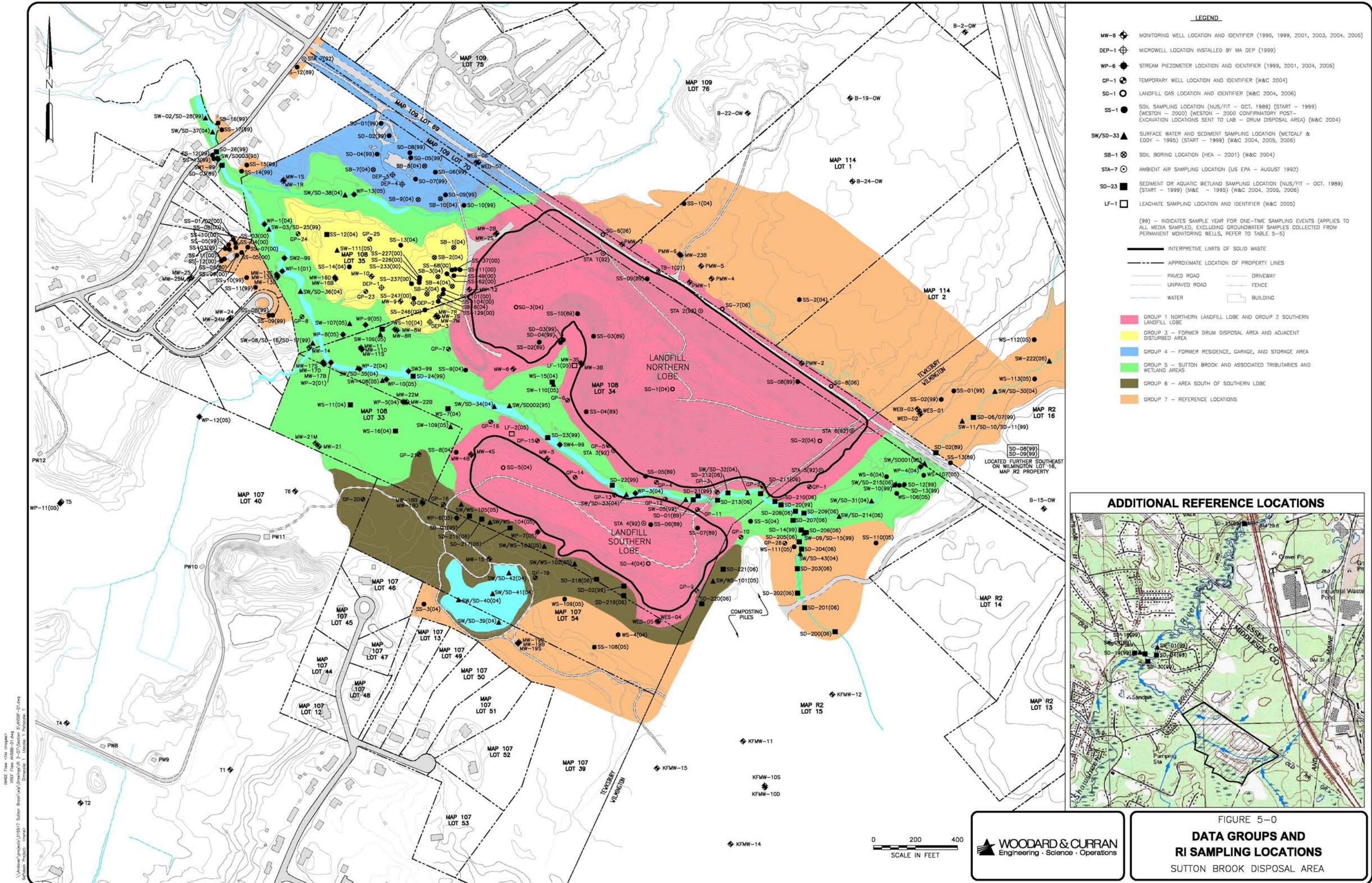
Date	Residence	Water Source	Date Sampled	VOC's (ug/l)	SVOC's (ug/l)	Pest./PCBs (ug/l)	Metals (mg/l)											
							Antimony	Arsenic	Barium	Cadmium	Copper	Lead	Mercury	Nickel	Selenium	Thallium	Vanadium	Zinc
December 1991 (Weston 1992)	1201 South St.	Private Well	Dec-91	Tetrachloroethylene = 0.67														
				1,1-Dichloroethane = 0.5														
				1,3-Dichlrobenzene = 1.4														
				1,1,1-Trichlorethane = 0.7														
				Trichlorofluoromethane = 0.4														
	1079 South St.	Private Well	Dec-91	Tetrachloroethylene = 0.5														
February 1992 (DHHS 2003)	22 Morningside Dr.	Irrigation Well	Feb-92	ND														
May - June 1999 (IT 2000)	1057 South St.	Irrigation Well	06/08/1999	ND	ND		0.11			0.01	<0.008	0.17		<0.01	0.08	<0.001		0.09
	1069 South St.	Private Well	06/02/1999	ND	Bis-(2-ethylhexyl) phthalate = 8.64		<0.0002			0.009	<0.008	<0.001		<0.01	<0.002	0.002		0.04
		Private Well	06/08/1999	ND	ND		<0.002			0.03	<0.008	0.03		<0.01	<0.002	0.002		0.004
		Private Well	06/03/1999	ND	ND		<0.02			0.02	0.61	0.012		0.02	0.001	<0.001		0.07
August 1999 (Weston 2000)	20 Shady Lane ^a	Private Well	8/12/1999	ND	ND	ND	<0.003	<0.003	0.0096	<0.001	0.0966	<0.0056	<0.0001	<0.001	<0.0004	<0.003	<0.001	0.0636
	36 Shady Lane ^a	Private Well	8/12/1999	ND	ND	ND	<0.003	0.0035J	0.0045	<0.001	0.264	<0.0011J	<0.0001	0.0012J	<0.0004	<0.003	<0.001	0.014
	1201 South St. ^a	Private Well	8/12/1999	1,3-Dichlrobenzene = 0.6J	Phenol = 1.0J	ND	<0.003	<0.003	0.0208	0.0013J	0.0952	0.0132	<0.0001	0.009	<0.0004	<0.003	<0.001	0.0491
	1069 South St. ^a	Private Well	8/12/1999	ND	ND	ND	<0.003	0.004J	0.0105	<0.001	0.0103	<0.001	0.00026	<0.001	<0.0004	<0.003	<0.001	0.0164
	1057 South St. ^a	Irrigation Well	8/12/1999	ND	ND	ND	<0.003	<0.003	0.0359	<0.001	0.003	<0.0017J	<0.0001	0.0033	<0.0004	<0.003	<0.001	0.0347
	68 Delwood ^a	Private Well	8/12/1999	ND	Bis-(2-ethylhexyl) phthalate = 1.0J	ND	<0.003	0.0282	0.0081	0.0013J	0.002J	<0.0025	<0.0001	<0.001	<0.0004	<0.003	<0.001	0.0352
	241 Pringle St. ^a	Private Well	8/12/1999	ND	ND	ND	<0.0032J	0.0069	0.0039	<0.001	0.005	<0.001	<0.0001	<0.001	<0.0004	<0.003	<0.001	<0.0054
	1079 South St. ^a	Private Well	8/12/1999	ND	ND	ND	<0.003	<0.003	0.005	<0.001	0.0014J	<0.001	<0.0001	<0.001	<0.0004	<0.003	<0.001	<0.0052
August 2002 (DHHS 2003)	Shady Lane	Private Well	Aug-02	ND ¹	ND ¹	ND ¹	Arsenic (multiple wells on South Street = 0.0012 - 0.035; Iron (1 well on Shady Lane) = 13.7; Manganese (monitoring wells on South St & Homestead Lane) = 0.197 - 0.291											
	South Street (3 homes)	Private Well	Aug-02	ND ¹	ND ¹	ND ¹												
	1057 South St.	Private Well (inactive/irrigation)	Aug-02	ND ¹	ND ¹	ND ¹												
	1201 South St.	Private Well (inactive/irrigation)	Aug-02	ND ¹	ND ¹	ND ¹												
	Carleton Road	Private Well	Aug-02	ND ¹	ND ¹	ND ¹												
		Private Well																
	Homestead Lane	(inactive/irrigation)	Aug-02	Tetrahydrofuran = 25	ND ¹	ND ¹												
Maximum Contaminant Level (MCL)				Compound Specific (see below)	Compound Specific (see below)	Compound Specific (see below)	0.006	0.01 ^b	2.0	0.005	1.3 ^c	0.015 ^c	0.002	NE	0.05	0.002	NE	NE

Data Sources:
Weston 1992 - Preliminary Assessment/Site Investigation, Emergency Planning & Response Branch, Roy F. Weston, Inc., February 1992.
IT 2000 - Preliminary Data Report, Rocco Landfill Investigation Area, IT Corp., February 2000.
Weston 2000 - Final Summary Site Report, Superfund Technical Assessment & Response Team, Roy F. Weston, Inc., March 2000.
DHHS 2003 - United States Department of Human Health Services, Public Health Assessment Report of Sutton Brook Disposal Area, May 23, 2003.

Notes:
Blank space indicates sample was not submitted for analysis indicated.
< = Not detected above the laboratory's minimum reporting limit shown.
ND = Not detected above the laboratory's minimum reporting limit (as indicated from data source).
ND¹ = Data source (DHHS 2003) does not present/discuss detectable levels of contaminants for the specific laboratory analyses. As a result data is presumed to be non-detect.
Concentrations shown in bold detected above the laboratories minimum reporting limit.
^a = August 1999 analytical data also analyzed for additional inorganic constituents (aluminum, beryllium, calcium, cobalt, copper, iron, magnesium, manganese, potassium, silver, sodium and cyanide). No concentrations of beryllium, chromium, cobalt, silver, or cyanide were detected in excess of the laboratory's minimum reporting limits.
No MCLs or Action Levels are currently established for these constituents.

MCL = The highest level of a contaminant that is allowed in drinking water.
Concentrations of aluminum, calcium, iron, magnesium, manganese, and potassium were detected. All other detected VOC contaminants (1,1-dichloroethane, 1,3-Dichlorobenzene, trichlorofluoromethane and tetrahydrofuran) do not have established MCLs.
Each quantified SVOC (bis-(2-ethylhexyl)phthalate and phenol) depicted on this table does not have an established MCL.
VOCs = Established MCLs for VOCs listed are as follows; PCE = 5.0 ug/l; 1,1,1-TCA = 200 ug/l. The MCL for total PCBs is 0.05 ug/l. No concentrations of pesticides or PCBs were detected above the laboratory's reporting limits.
SVOCs = Established MCLs for SVOCs are compound specific.
Pesticides/PCBs = Established MCLs for pesticides are compound specific.
= MCL effective date is 1/23/06.
NE = MCL not established for listed individual constituents.
= Action Level; copper and lead are regulated by Treatment Technique (process intended to levels of contaminants in drinking water) that requires system to control the corrosiveness of the water.

Shading indicates reported concentration exceeds drinking water standard (MCL) or Action Level.
J = estimated concentration as noted from data source.



LEGEND

- MW-5 MONITORING WELL LOCATION AND IDENTIFIER (1995, 1999, 2001, 2003, 2004, 2005)
- DEP-1 MICROWELL LOCATION INSTALLED BY MA DEP (1999)
- WP-6 STREAM PIEZOMETER LOCATION AND IDENTIFIER (1999, 2001, 2004, 2005)
- GP-1 TEMPORARY WELL LOCATION AND IDENTIFIER (W&C 2004)
- SG-1 LANDFILL GAS LOCATION AND IDENTIFIER (W&C 2004, 2006)
- SS-1 SOIL SAMPLING LOCATION (NUS/FIT - OCT, 1989) (START - 1999) (WESTON - 2000) (WESTON - 2000 CONFIRMATORY POST-EXCAVATION LOCATIONS SENT TO LAB - DRUM DISPOSAL AREA) (W&C 2004)
- SW/SD-33 SURFACE WATER AND SEDIMENT SAMPLING LOCATION (METCALF & EDDY - 1995) (START - 1999) (W&C 2004, 2005, 2006)
- SB-1 SOIL BORING LOCATION (HEA - 2001) (W&C 2004)
- STA-7 AMBIENT AIR SAMPLING LOCATION (US EPA - AUGUST 1992)
- SD-23 SEDIMENT OR AQUATIC WETLAND SAMPLING LOCATION (NUS/FIT - OCT, 1989) (START - 1999) (M&E - 1995) (W&C 2004, 2005, 2006)
- LF-1 LEACHATE SAMPLING LOCATION AND IDENTIFIER (W&C 2005)

(99) - INDICATES SAMPLE YEAR FOR ONE-TIME SAMPLING EVENTS (APPLIES TO ALL MEDIA SAMPLED, EXCLUDING GROUNDWATER SAMPLES COLLECTED FROM PERMANENT MONITORING WELLS, REFER TO TABLE 5-5)

- INTERPRETIVE LIMITS OF SOLID WASTE
- APPROXIMATE LOCATION OF PROPERTY LINES
- PAVED ROAD
- UNPAVED ROAD
- WATER
- DRIVEWAY
- FENCE
- BUILDING

- GROUP 1 NORTHERN LANDFILL LOBE AND GROUP 2 SOUTHERN LANDFILL LOBE
- GROUP 3 - FORMER DRUM DISPOSAL AREA AND ADJACENT DISTURBED AREA
- GROUP 4 - FORMER RESIDENCE, GARAGE, AND STORAGE AREA
- GROUP 5 - SUTTON BROOK AND ASSOCIATED TRIBUTARIES AND WETLAND AREAS
- GROUP 6 - AREA SOUTH OF SOUTHERN LOBE
- GROUP 7 - REFERENCE LOCATIONS

ADDITIONAL REFERENCE LOCATIONS

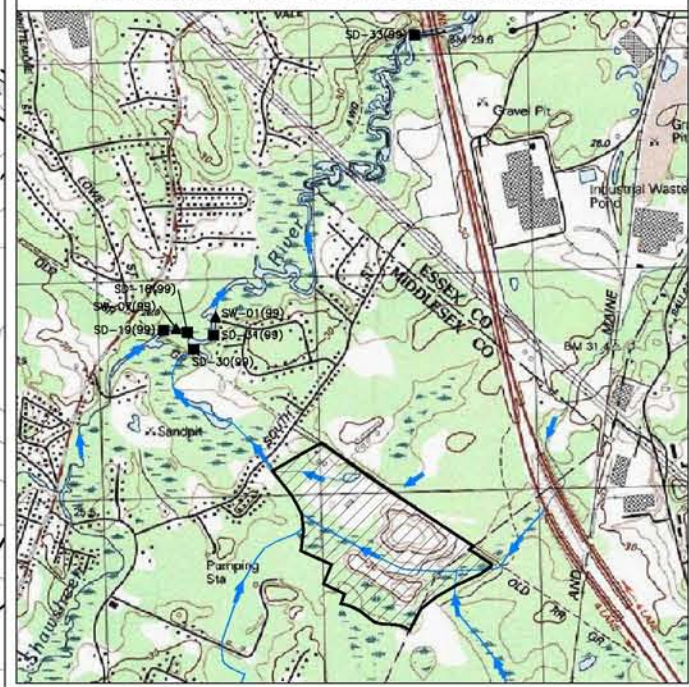
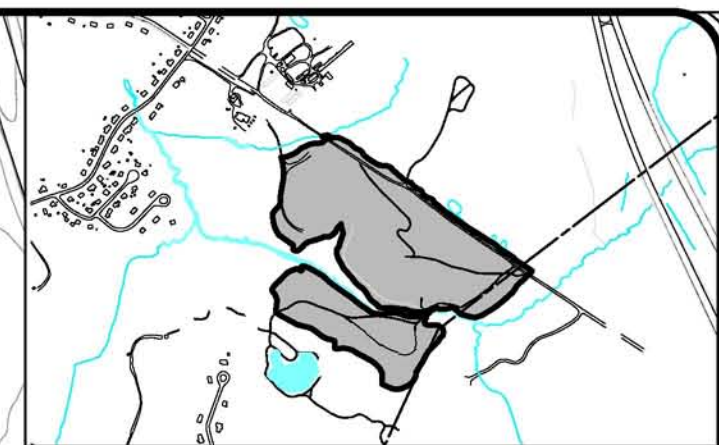
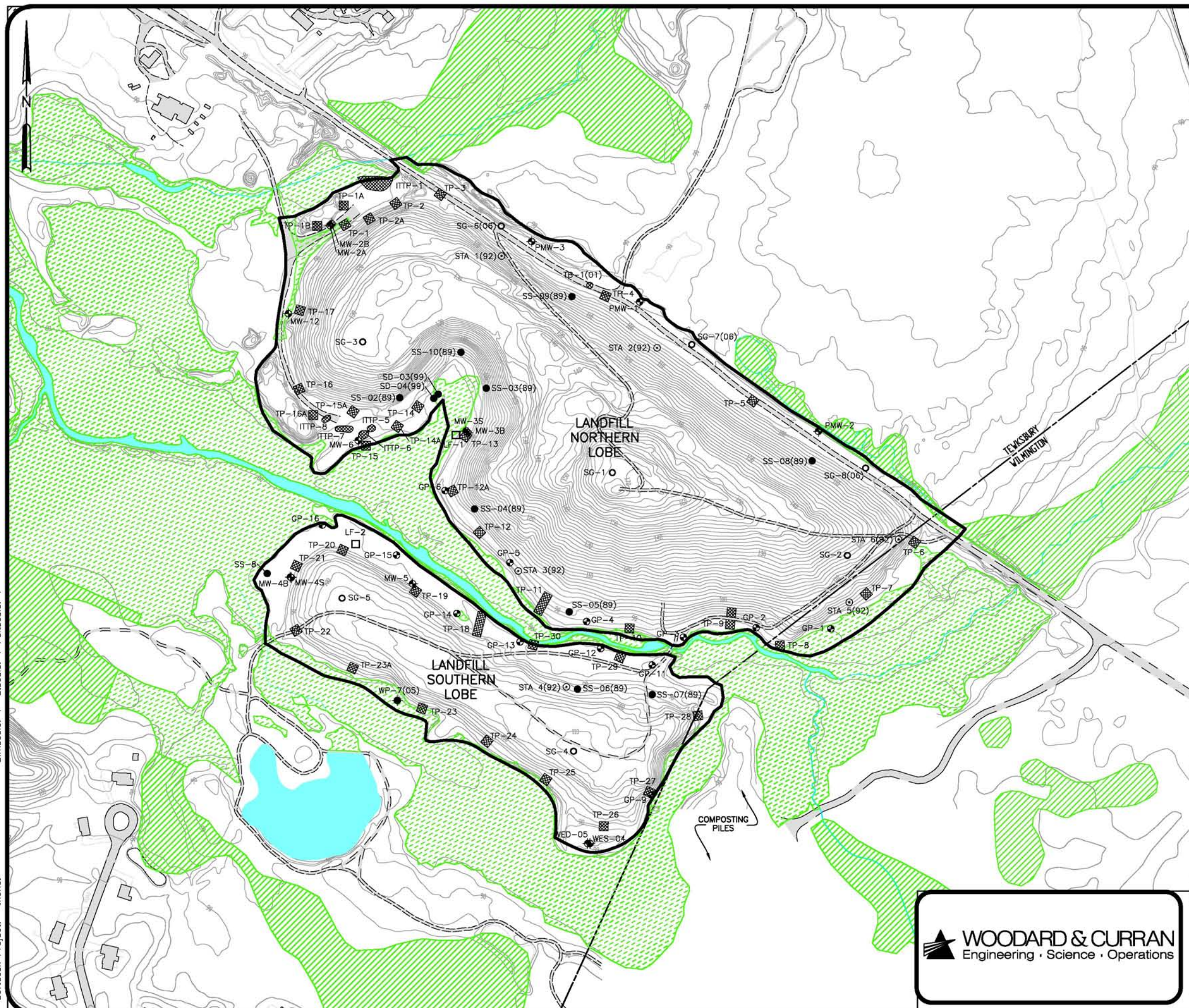


FIGURE 5-0
DATA GROUPS AND
RI SAMPLING LOCATIONS
SUTTON BROOK DISPOSAL AREA

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USER: jcurran
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PLOT SCALE: 1"=100'

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LEGEND


GP-1 ● TEMPORARY WELL LOCATION AND IDENTIFIER (W&C 2004)
SG-1 ○ LANDFILL GAS LOCATION AND IDENTIFIER (W&C 2004, 2006)
TP-2 ▣ TEST PIT LOCATION AND IDENTIFIER (W&C 2004)
ITTP = TEST PIT INSTALLED BY IT CORPORATION
MW-6 ● MONITORING WELL LOCATION AND IDENTIFIER (1995, 1999, 2001, 2003, 2004, 2005)
SS-08 ● SOIL SAMPLING LOCATION (NUS/FIT - OCT. 1989) (START - 1999)
LF-1 □ LEACHATE SAMPLING LOCATION AND IDENTIFIER (W&C 2005)
TB-1 ⊗ SOIL BORING LOCATION (HEA - 2001)
STA-4 ○ AMBIENT AIR SAMPLING LOCATION (US EPA - AUGUST 1992)
WP-7 ● STREAM PIEZOMETER LOCATION AND IDENTIFIER (W&C 2005)
(99) - INDICATES SAMPLE YEAR

WETLAND BOUNDARY DELINEATED IN ACCORDANCE WITH US ACOE 1987 METHODS
WETLAND AREA DELINEATED BY AERIAL PHOTOGRAPH INTERPRETATION

DATA GROUP LIMITS

UNPAVED ROAD PAVED ROAD
WATER BUILDING

0 300 600
SCALE IN FEET



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FIGURE 5-1a
**NORTHERN LANDFILL LOBE AND
SOUTHERN LANDFILL LOBE**
SUTTON BROOK DISPOSAL AREA

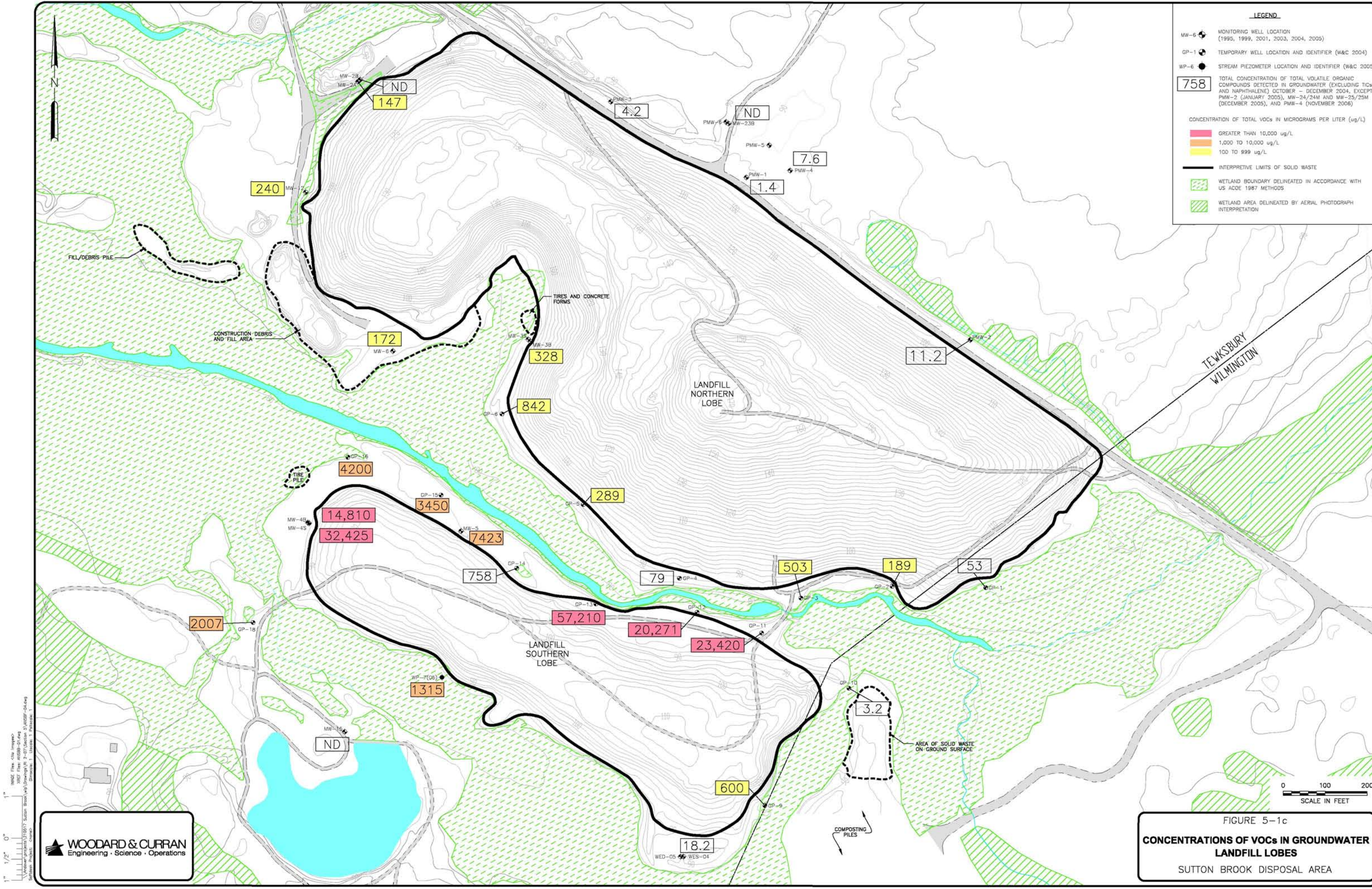


FIGURE 5-1c
**CONCENTRATIONS OF VOCs IN GROUNDWATER
LANDFILL LOBES**
SUTTON BROOK DISPOSAL AREA

IMAGE Files <file images>
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MADE FROM: 1/10/17
PROJECT: 1/10/17
DATE: 1/10/17
SUTTON BROOK DISPOSAL AREA
WILMINGTON, MA
SCALE: 1" = 100'

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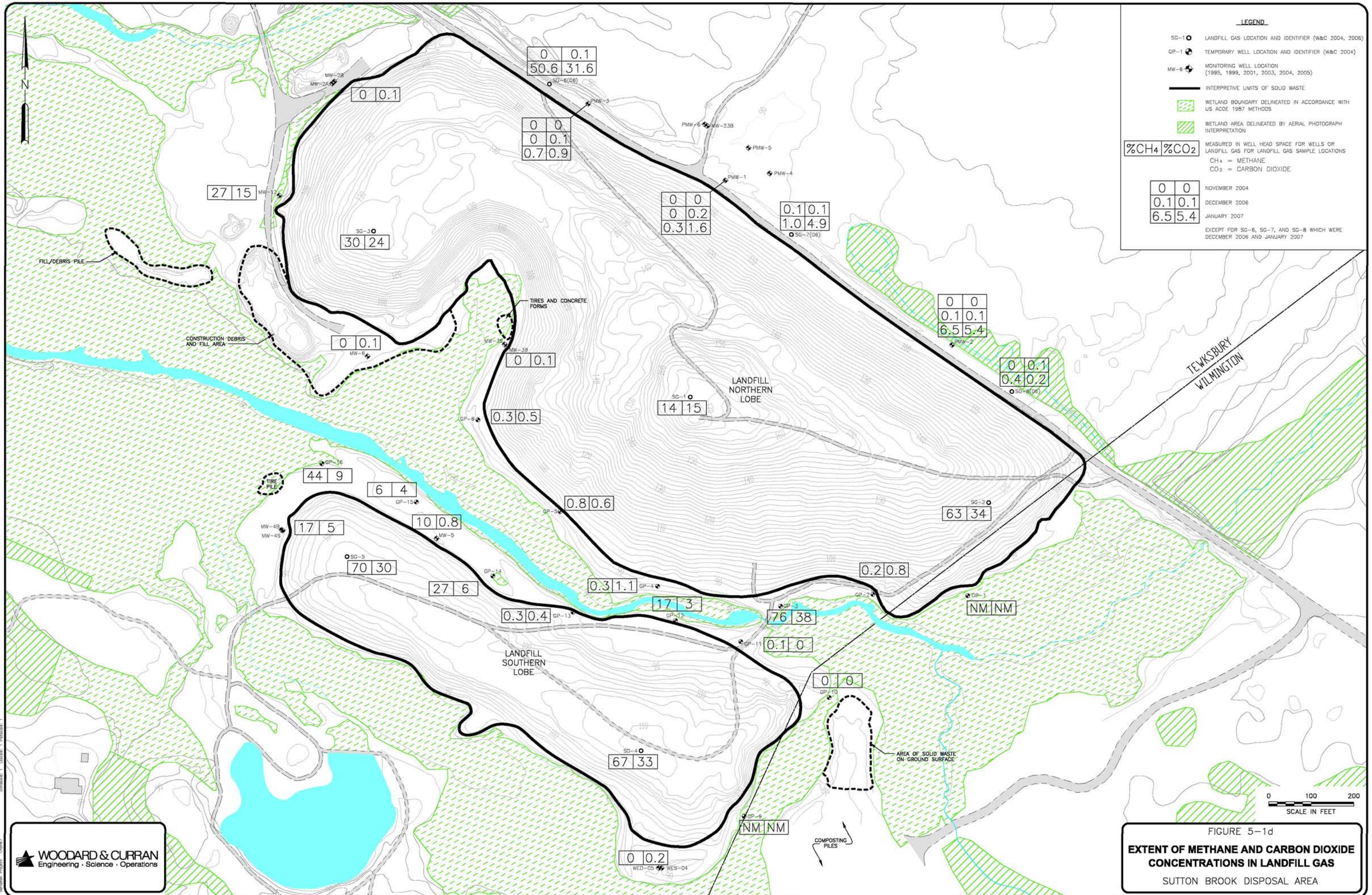
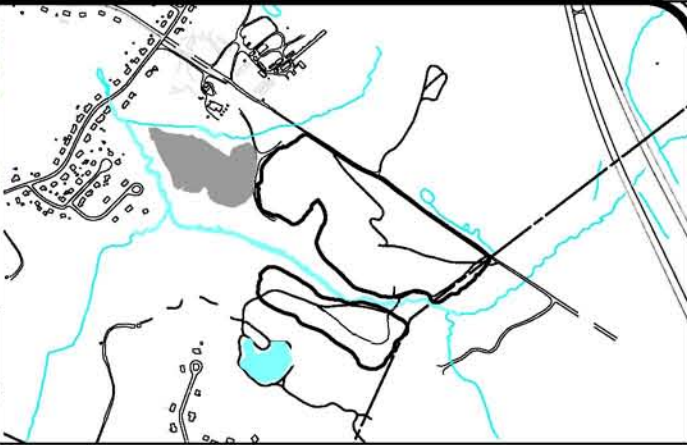
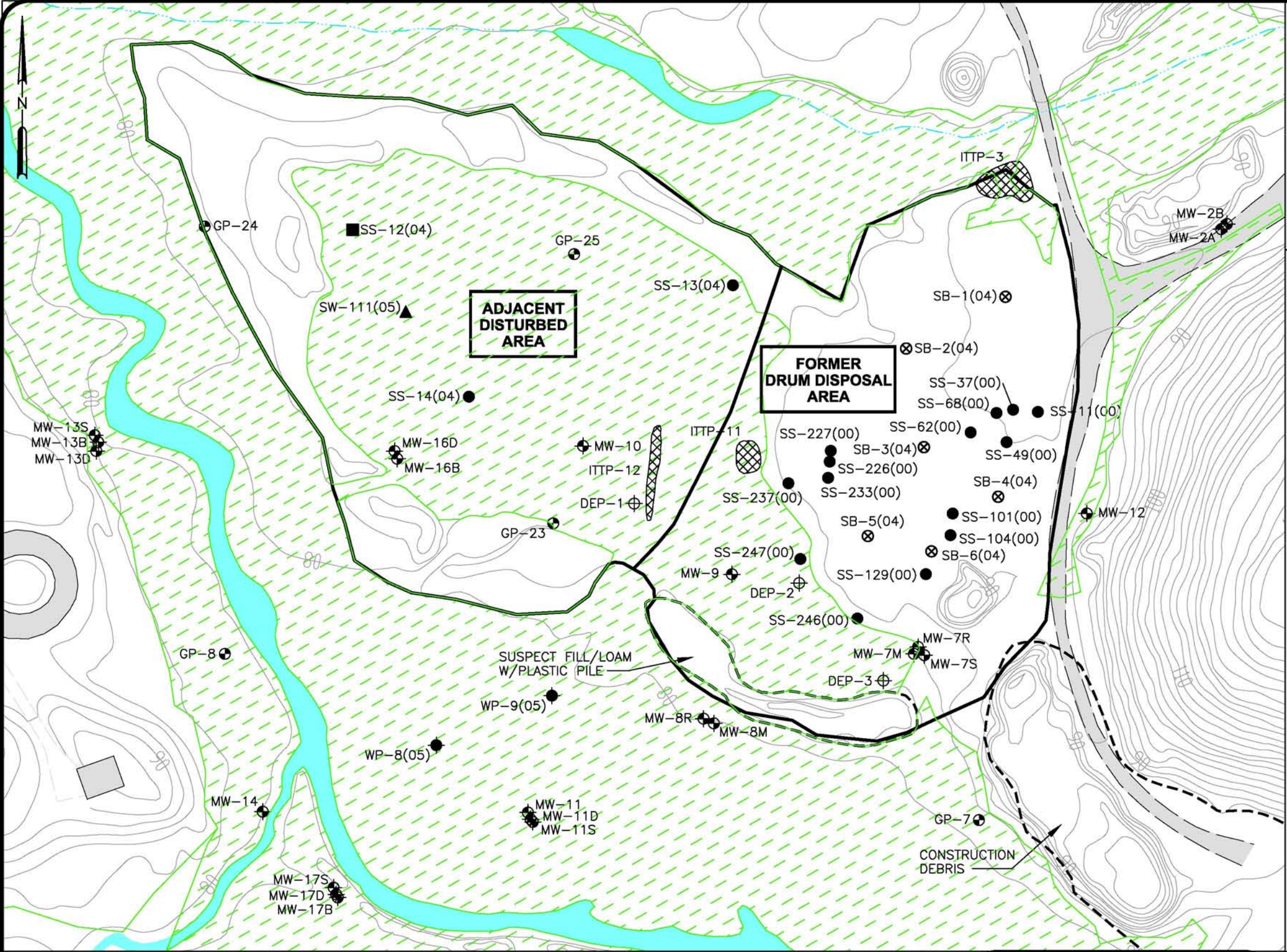


FIGURE 5-1d
EXTENT OF METHANE AND CARBON DIOXIDE CONCENTRATIONS IN LANDFILL GAS
SUTTON BROOK DISPOSAL AREA

IMAGE Files: <No Images>
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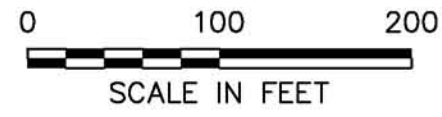


LEGEND

- GP-25 ● TEMPORARY WELL LOCATION AND IDENTIFIER
- SB-1 ⊗ SOIL BORING LOCATION AND IDENTIFIER
- SS-14 ● SURFACE SOIL LOCATION AND IDENTIFIER
WS = WETLAND SOIL
- SS-12 ■ SEDIMENT LOCATION AND IDENTIFIER (AQUATIC WETLAND)
- WP-8 ● STREAM PIEZOMETER LOCATION AND IDENTIFIER
- SW-111 ▲ SURFACE WATER LOCATION AND IDENTIFIER
- ⊕ MICROWELL LOCATION INSTALLED BY MA DEP
- ⊕ MONITORING WELL LOCATION AND IDENTIFIER
(1995, 1999, 2001, 2003, 2004, 2005)
- SOIL SAMPLING LOCATION (WESTON - 2000)
- ⊗ ITTP = TEST PIT INSTALLED BY IT CORPORATION
- WETLAND AREAS
- UNPAVED ROAD
- PAVED ROAD
- WATER
- BUILDING

NOTE:

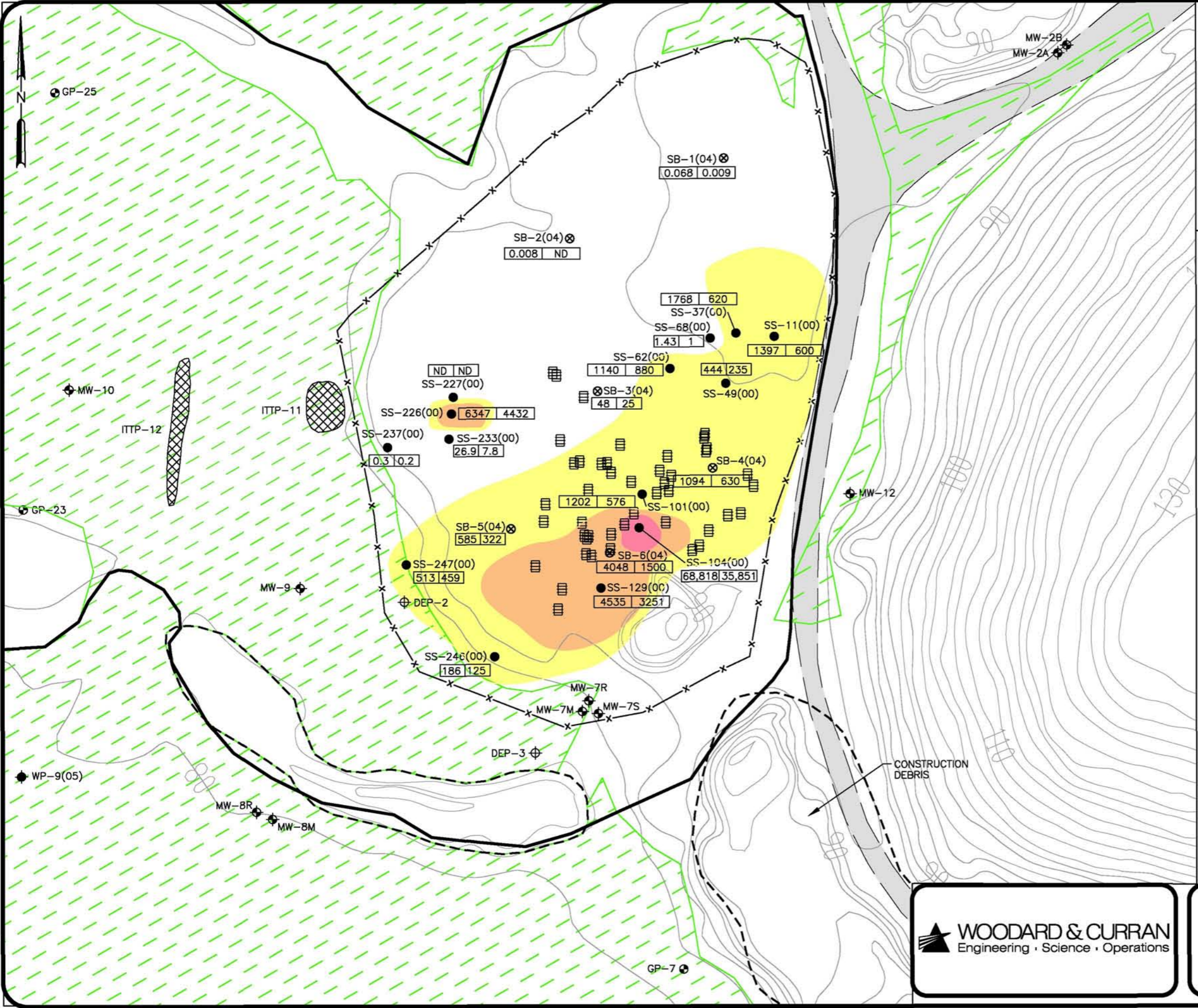
THE LOCATION FOR SIX OF THE 20 SOIL SAMPLES COLLECTED IN 2000 BY WESTON ARE NOT SHOWN ON THIS DRAWING GIVEN THEY WERE NOT SHOWN ON THE WESTON MARCH 2002 REPORT DRAWING.



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FIGURE 5-2a
FORMER DRUM DISPOSAL AREA
AND ADJACENT DISTURBED AREA
SUTTON BROOK DISPOSAL AREA

IMAGE Files: <No Images>
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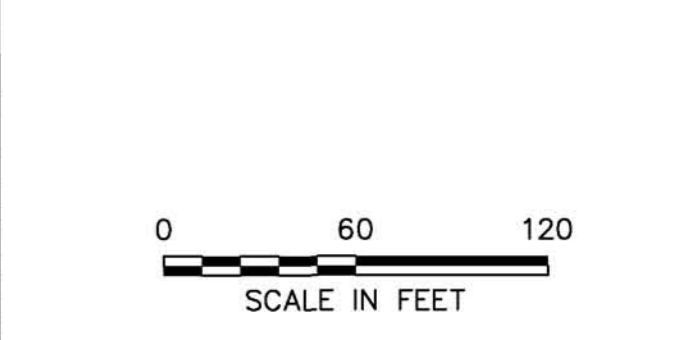
LEGEND

- GP-25 ● TEMPORARY WELL LOCATION AND IDENTIFIER
- SB-1 ⊗ SOIL BORING LOCATION AND IDENTIFIER
- WP-9 ● STREAM PIEZOMETER LOCATION AND IDENTIFIER
- ⊕ MICROWELL LOCATION INSTALLED BY MA DEP
- ⊕ MONITORING WELL LOCATION AND IDENTIFIER (1995, 1999, 2001, 2003, 2004, 2005)
- SOIL SAMPLING LOCATION (WESTON - 2000)
- ⊗ ITTP = TEST PIT INSTALLED BY IT CORPORATION
- ⊞ FORMER DRUM/DRUM CLUSTER (FROM IT CORPORATION FEBRUARY 28, 2000 REPORT)
- ▨ WETLAND AREAS
- x — FORMER FENCE
- UNPAVED ROAD
- PAVED ROAD
- WATER
- ▭ BUILDING

1768 | 620 TOTAL VOCs| XYLENES CONCENTRATION IN MILLIGRAMS PER KILOGRAM (mg/kg)

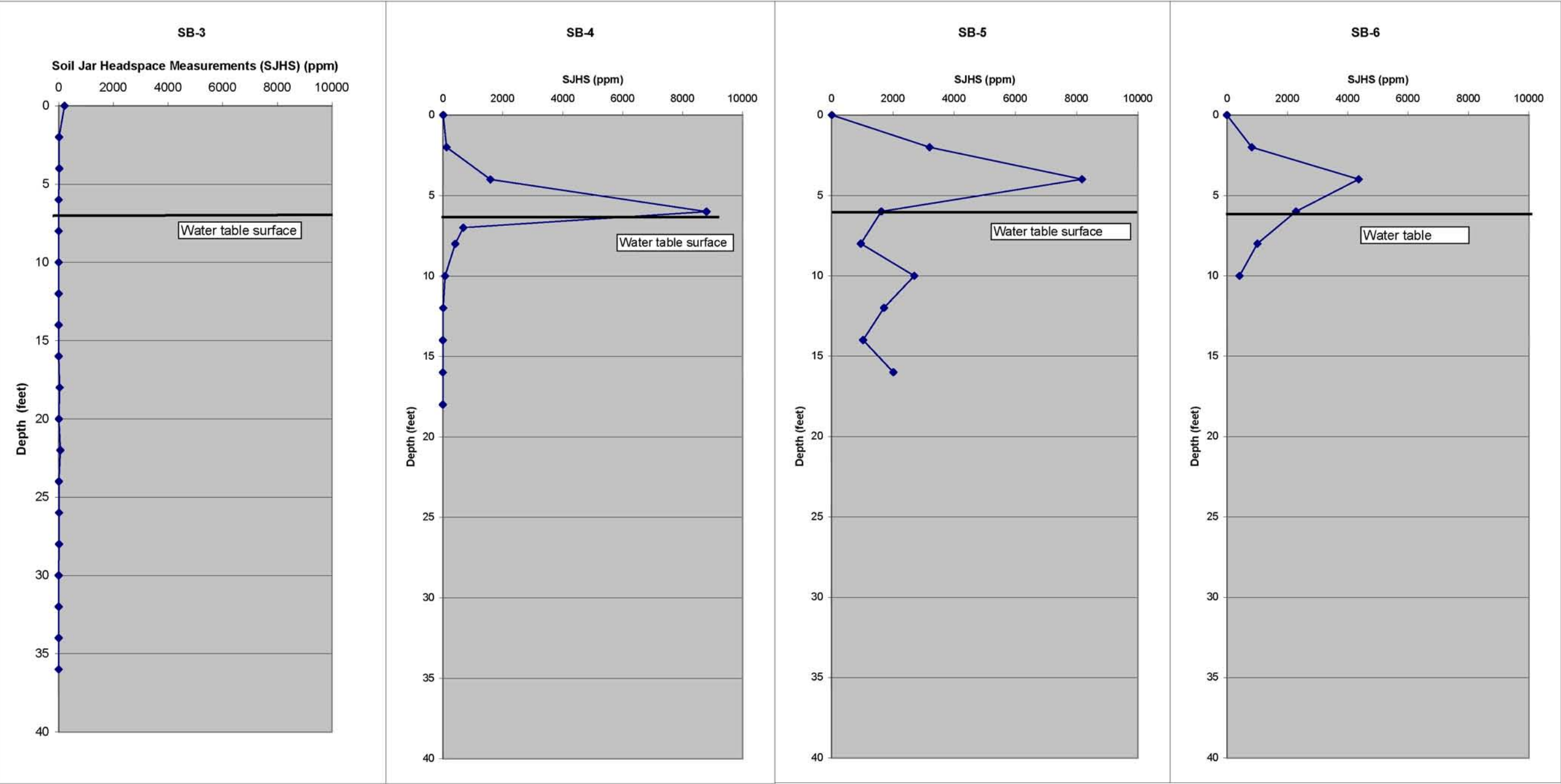
CONCENTRATION OF XYLENES

- GREATER THAN 10,000 mg/kg
- 1,000 TO 10,000 mg/kg
- 100 TO 999 mg/kg



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FIGURE 5-2b
**INTERPRETIVE EXTENT OF RESIDUAL
VOCs IN SOIL - FORMER DRUM DISPOSAL AREA**
SUTTON BROOK DISPOSAL AREA

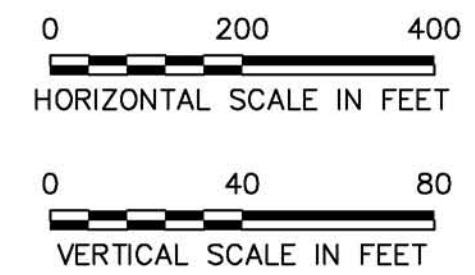
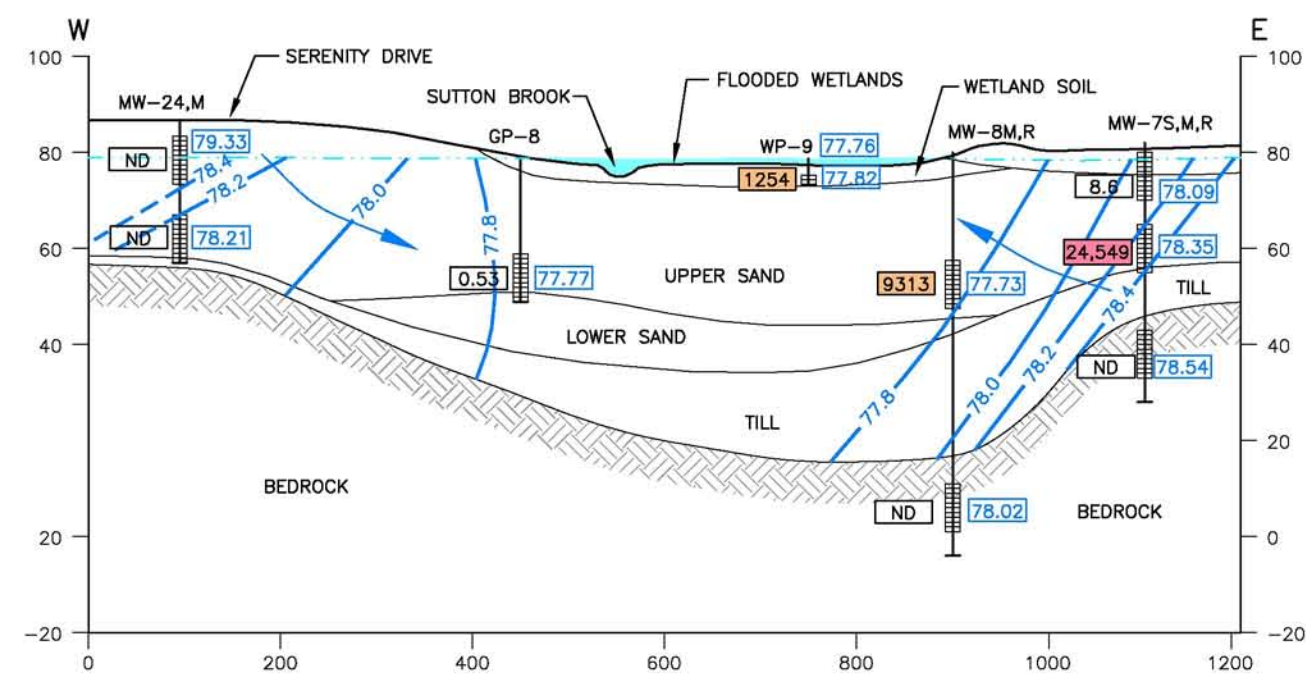


Legend

◆ = Soil Sample

Figure 5-2c
Vertical Profile of Soil Jar Headspace Measurements -
Soil Borings
Former Drum Disposal Area
Sutton Brook Disposal Area

IMAGE Files: <No Images>
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\\Andover\projects\210517 Sutton Brook wip\Drawings\RI 2-07\Section 5\ANSBF-08.dwg
Dimstyle: 1 Ltscale: 1 Psitscale: 1
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- LEGEND**
- GP-25 ● TEMPORARY WELL LOCATION AND IDENTIFIER
 - DEP-1 ⊕ MICROWELL LOCATION INSTALLED BY MA DEP
 - MW-9 ⊕ MONITORING WELL LOCATION AND IDENTIFIER (1995, 1999, 2001)
 - SW-38 ▲ SURFACE WATER SAMPLING LOCATION AND IDENTIFIER
- NOVEMBER - DECEMBER 2004 GROUNDWATER AND SURFACE WATER DATA EXCEPT IF WELLS NOT INSTALLED AT THAT TIME. MOST RECENT DATA IS PRESENTED FOR THESE LOCATIONS.
- | | |
|------|-------------|
| 61.5 | TOTAL VOCs |
| 1.4 | TOTAL CVOCs |
| 6.2 | TOTAL BTEX |
- VOCs = VOLATILE ORGANIC COMPOUNDS
CVOCs = CHLORINATED VOCs - 1,1,1 TCA, TCE, AND 1,1 DCA
BTEX = BENZENE, TOLUENE, ETHYL BENZENE, AND XYLENES
- CONCENTRATION OF TOTAL VOCs IN MICROGRAMS PER LITER (ug/L)
- | |
|--------------------------|
| GREATER THAN 10,000 ug/L |
| 1,000 TO 10,000 ug/L |
| 100 TO 999 ug/L |
- 77.77 POTENTIOMETRIC HEAD ALTITUDE MEASURED ON DECEMBER 12, 2005
- 78.0 — GROUNDWATER CONTOUR. DASHED WHERE INFERRED.
- ← INFERRED GROUNDWATER FLOW DIRECTION, 12/12/05
- WETLAND AREAS
- CHLORINATED HYDROCARBONS — PASSIVE-VAPOR-DIFFUSION SAMPLER - SHOWS CONCENTRATIONS OF PETROLEUM HYDROCARBONS AND CHLORINATED HYDROCARBONS, IN PARTS PER BILLION BY VOLUME. (USGS, 2001).
- PETROLEUM HYDROCARBONS —
- | |
|--|
| GREATER THAN 10,000 |
| GREATER THAN 1,000 TO 10,000 |
| GREATER THAN 100 TO 1,000 |
| TRACE TO 100 |
| NOT DETECTED ABOVE REPORTING LIMIT OR AT TRACE LEVEL |
| SAMPLER NOT FOUND |

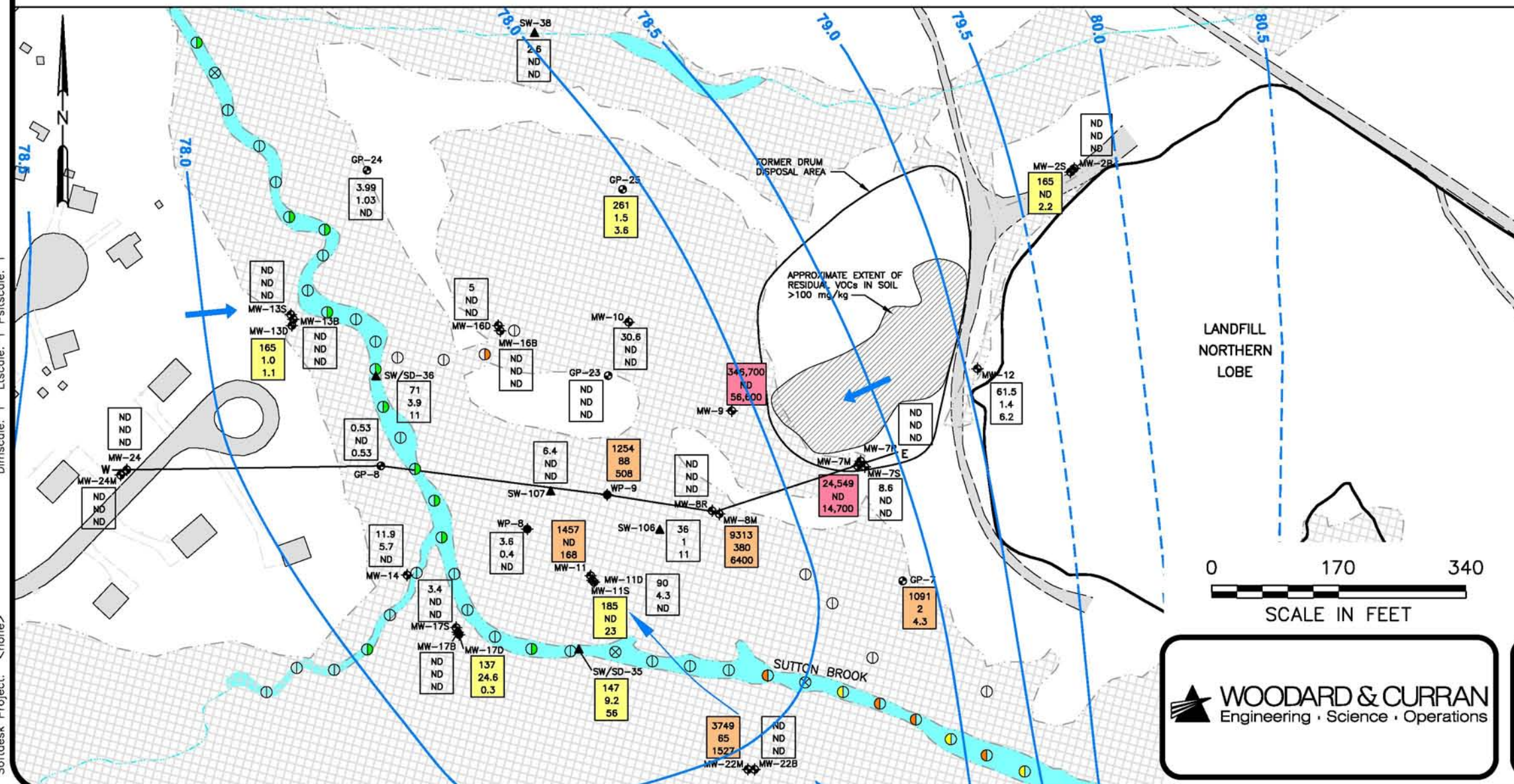
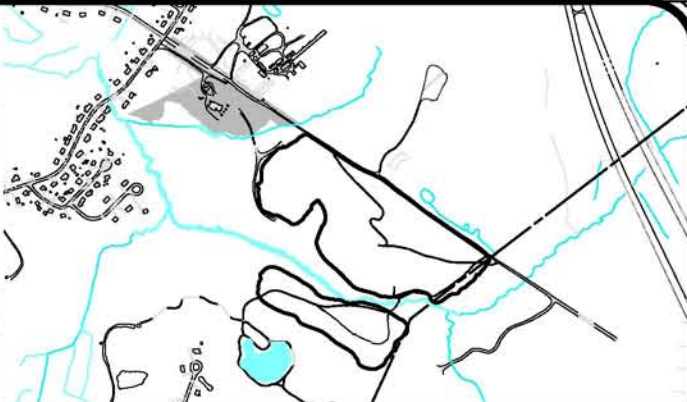
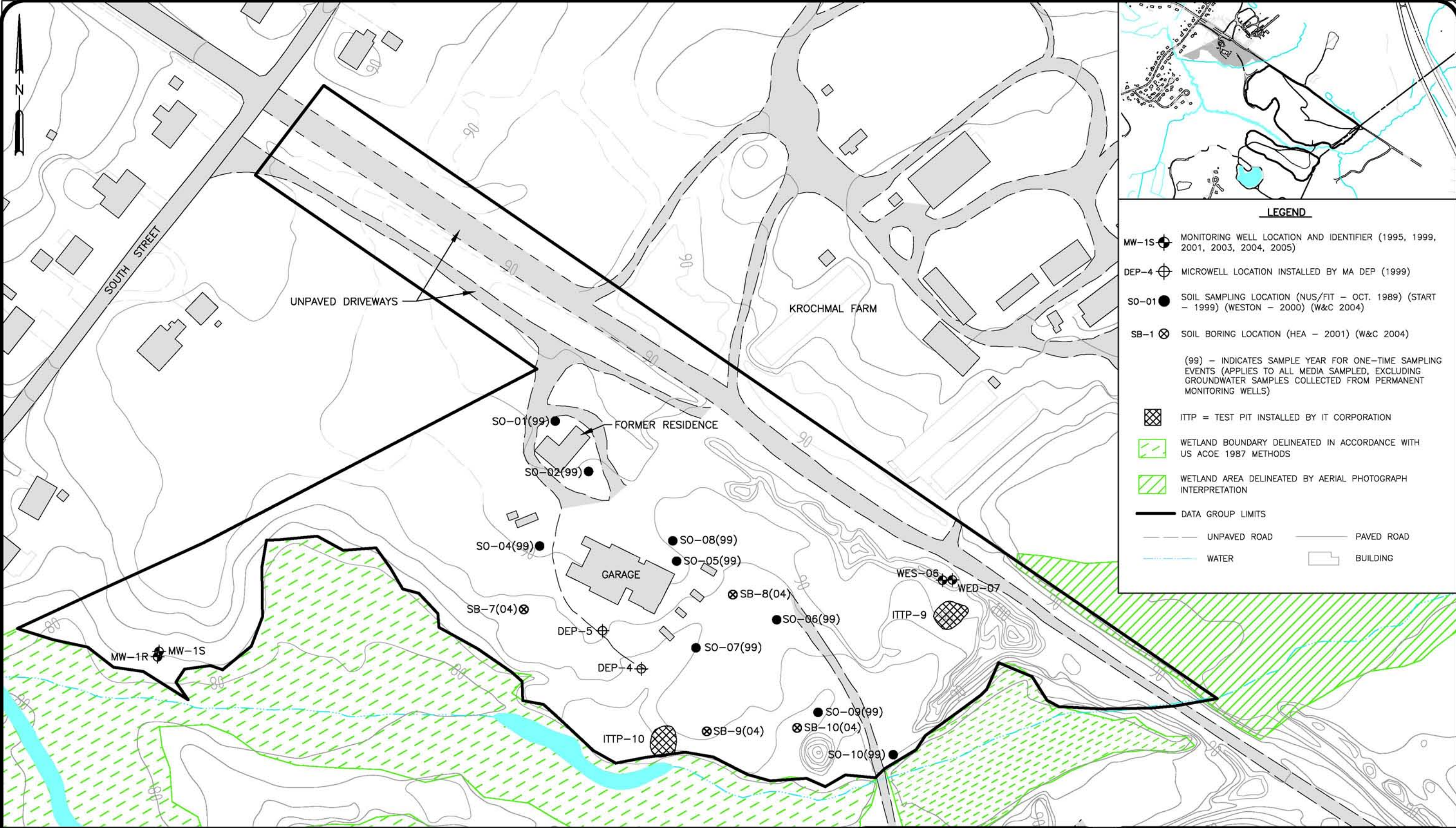


IMAGE Files: <No Images>
XREF Files: ANSBB-01.dwg
\\Andover\projects\210517 Sutton Brook wip\Drawings\RI 2-07\Section 5\ANSBF-09.dwg
Dimstyle: 1 Ltscale: 1 Psitscale: 1
Softdesk Project: <none>



LEGEND

MW-1S ● MONITORING WELL LOCATION AND IDENTIFIER (1995, 1999, 2001, 2003, 2004, 2005)

DEP-4 ⊕ MICROWELL LOCATION INSTALLED BY MA DEP (1999)

SO-01 ● SOIL SAMPLING LOCATION (NUS/FIT - OCT. 1989) (START - 1999) (WESTON - 2000) (W&C 2004)

SB-1 ⊗ SOIL BORING LOCATION (HEA - 2001) (W&C 2004)

(99) - INDICATES SAMPLE YEAR FOR ONE-TIME SAMPLING EVENTS (APPLIES TO ALL MEDIA SAMPLED, EXCLUDING GROUNDWATER SAMPLES COLLECTED FROM PERMANENT MONITORING WELLS)

ITTP = TEST PIT INSTALLED BY IT CORPORATION

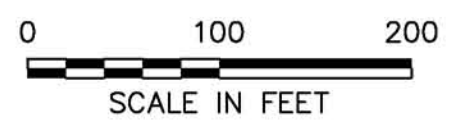
WETLAND BOUNDARY DELINEATED IN ACCORDANCE WITH US ACOE 1987 METHODS

WETLAND AREA DELINEATED BY AERIAL PHOTOGRAPH INTERPRETATION

DATA GROUP LIMITS

UNPAVED ROAD PAVED ROAD

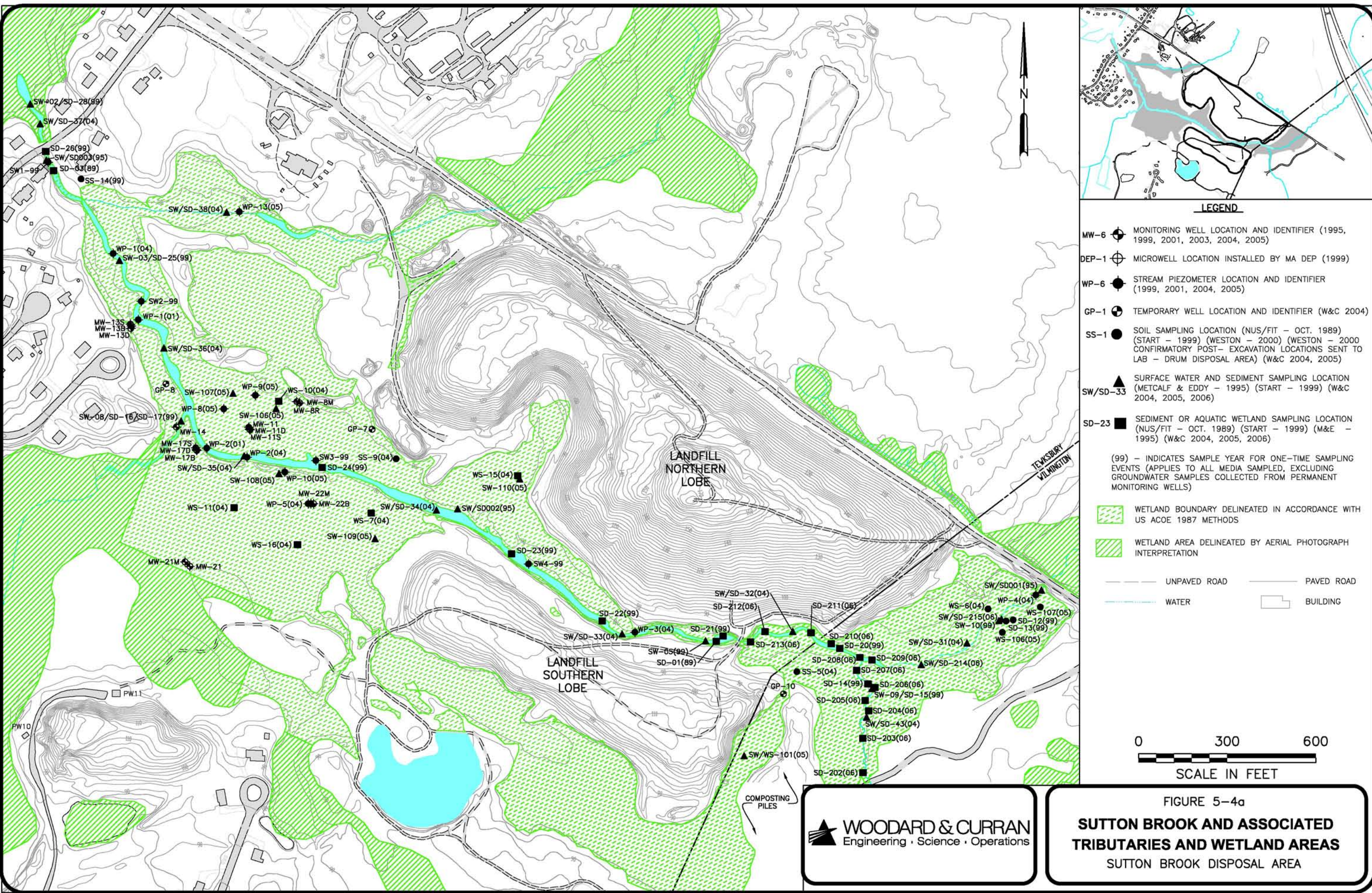
WATER BUILDING



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FIGURE 5-3a
FORMER RESIDENCE, GARAGE,
AND STORAGE AREA
SUTTON BROOK DISPOSAL AREA

IMAGE Files: <No Images>
XREF Files: ANSBB-01.dwg
\\Andover\projects\210517 Sutton Brook wip\Drawings\RI 2-07\Section 5\ANSBF-10.dwg
Software Project: <none>
Dimstyle: 1 Ltscale: 1 Psitscale: 1



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FIGURE 5-4a
**SUTTON BROOK AND ASSOCIATED
TRIBUTARIES AND WETLAND AREAS**
SUTTON BROOK DISPOSAL AREA

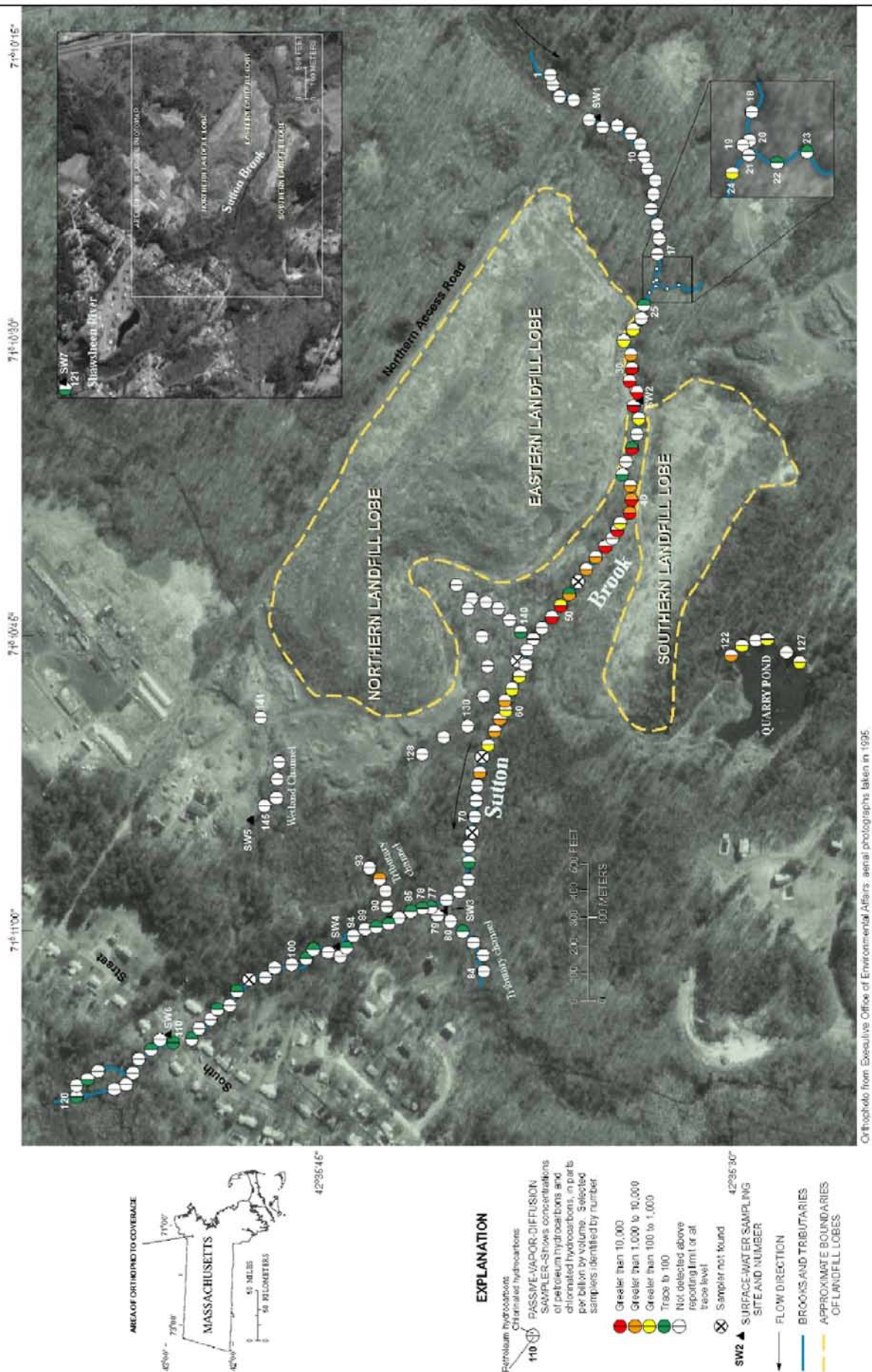
PASSIVE VAPOR DIFFUSION SAMPLE SURVEY

DESIGNED BY: CHECKED BY:
DRAWN BY: EVR ANSBF-19 Surv Smp 5-4b.dwg

SUTTON BROOK DISPOSAL AREA

JOB NO: 210517
DATE: FEBRUARY 2007
SCALE: NOT TO SCALE

FIGURE 5-4b



TAKEN FROM: USGS/EPA DISTRIBUTION OF VOLATILE ORGANIC COMPOUNDS IN SEDIMENTS NEAR SUTTON BROOK DISPOSAL AREA, TEWKSBURY, MASSACHUSETTS, MAY 2001. OPEN FILE REPORT 02-138.

Cytophotos from Executive Office of Environmental Affairs: aerial photographs taken in 1995.

Figure 5-4c

Sutton Brook Field Chemistry Profiles
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

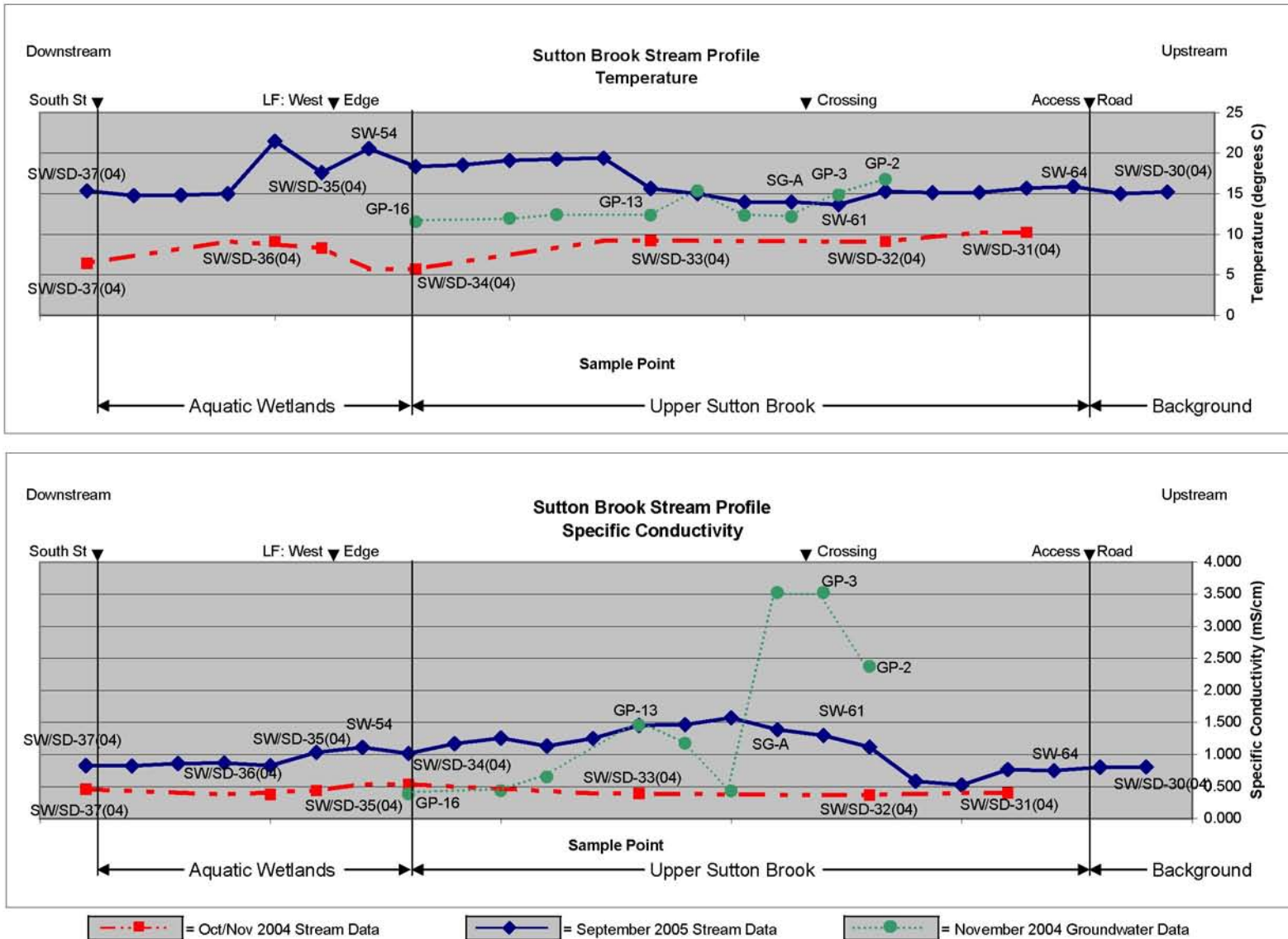


Figure 5-4c

Sutton Brook Field Chemistry Profiles
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

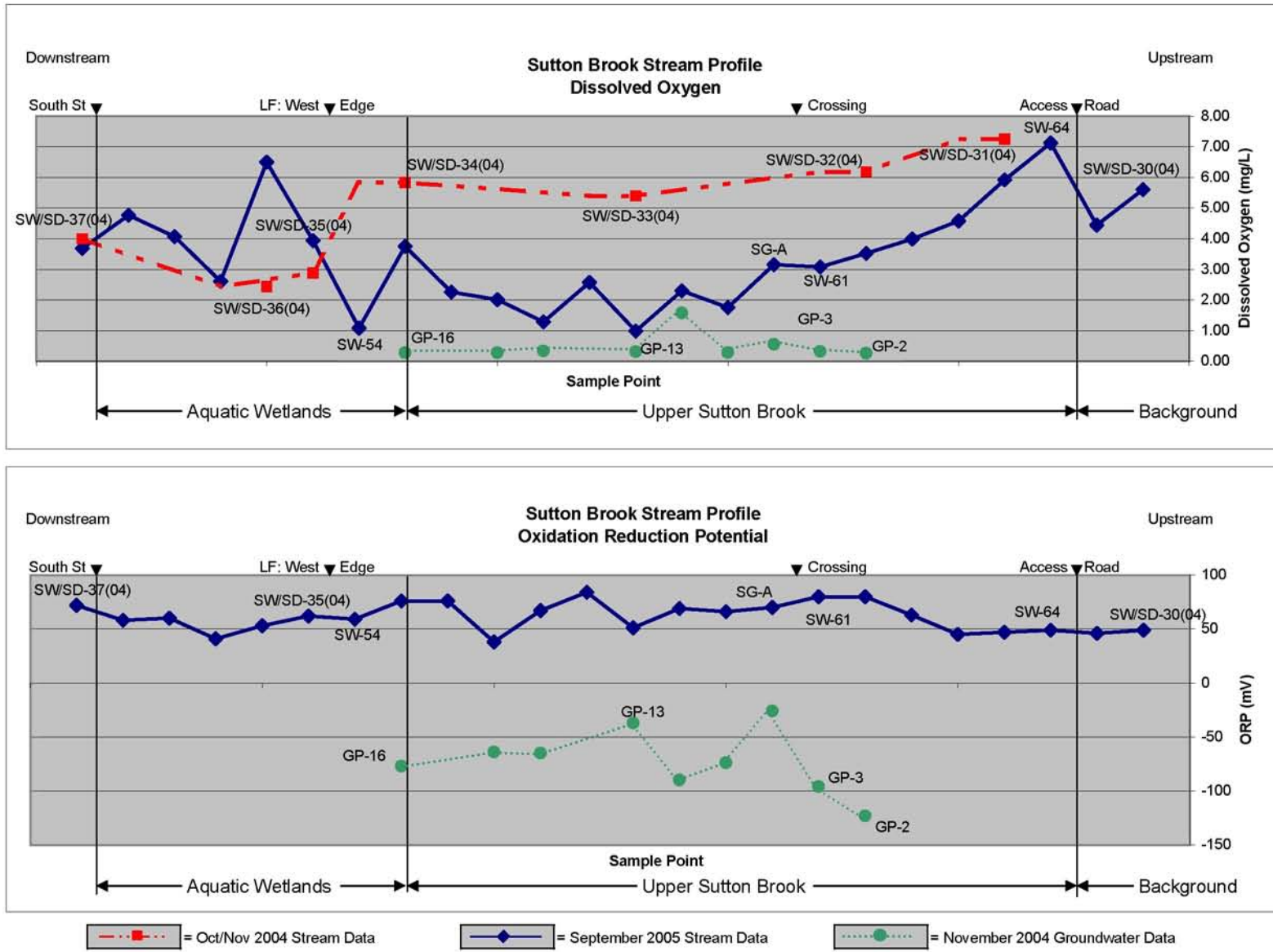
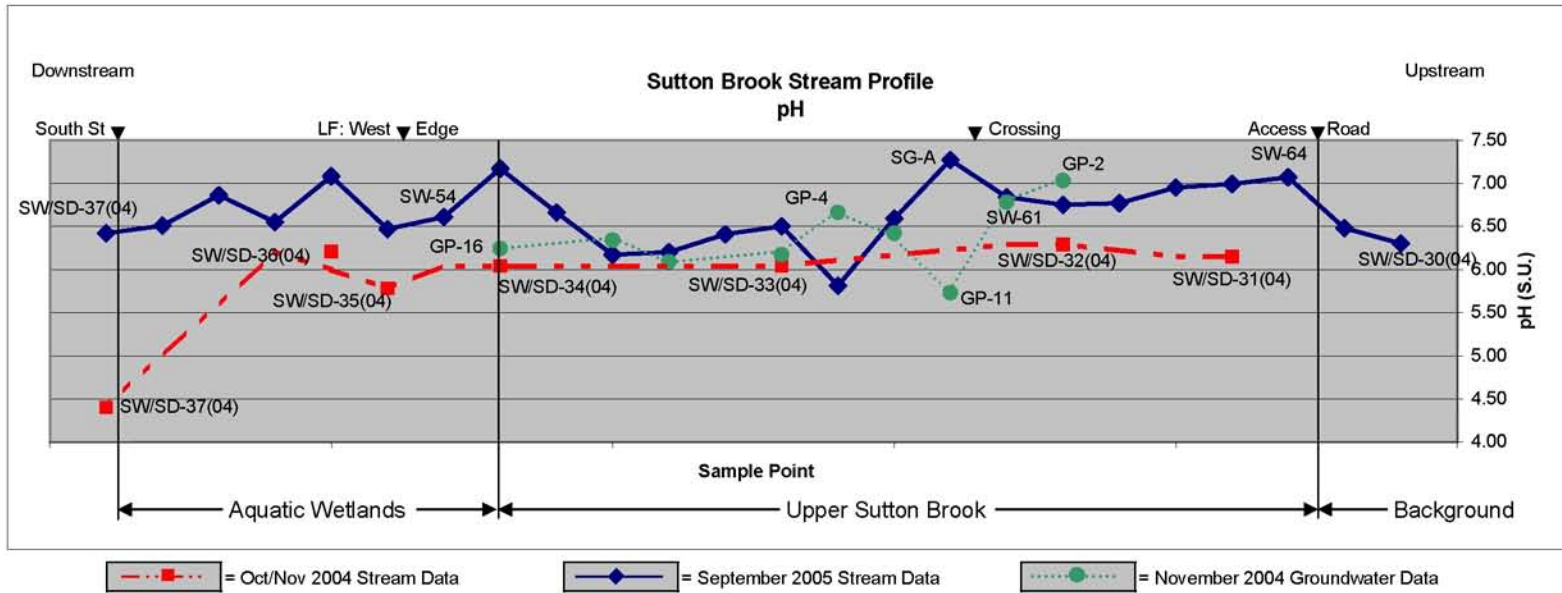
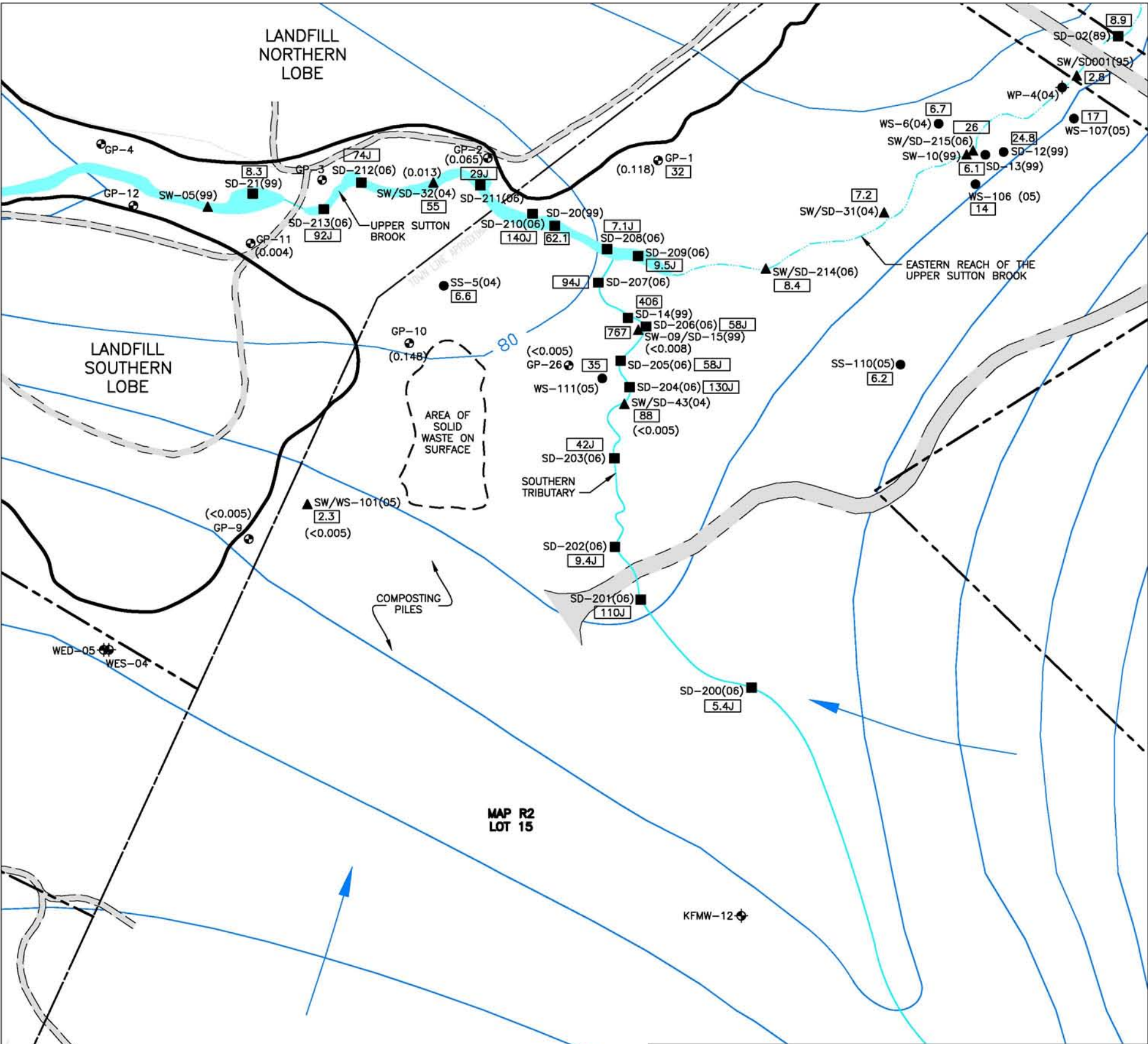


Figure 5-4c

Sutton Brook Field Chemistry Profiles
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts





LEGEND

MW-6

MONITORING WELL LOCATION AND IDENTIFIER
(1995, 1999, 2001, 2003, 2004, 2005)

WP-6

STREAM PIEZOMETER LOCATION AND IDENTIFIER
(1999, 2001, 2004, 2005)

GP-1

TEMPORARY WELL LOCATION AND IDENTIFIER (W&C 2004)

SS-1

SOIL SAMPLING LOCATION (NUS/FIT - OCT. 1989) (START - 1999) (WESTON - 2000) (WESTON - 2000 CONFIRMATORY POST- EXCAVATION LOCATIONS SENT TO LAB - DRUM DISPOSAL AREA) (W&C 2004)

SW/SD-33

SURFACE WATER AND SEDIMENT SAMPLING LOCATION (METCALF & EDDY - 1995) (START - 1999) (W&C 2004, 2005, 2006)

SD-23

SEDIMENT OR AQUATIC WETLAND SAMPLING LOCATION (NUS/FIT - OCT. 1989) (START - 1999) (M&E - 1995) (W&C 2004, 2005, 2006)

(99) - INDICATES SAMPLE YEAR FOR ONE-TIME SAMPLING EVENTS (APPLIES TO ALL MEDIA SAMPLED, EXCLUDING GROUNDWATER SAMPLES COLLECTED FROM PERMANENT MONITORING WELLS, REFER TO TABLE 5-5)

[88]

ARSENIC CONCENTRATION IN SEDIMENT OR SOIL, IN mg/kg

(<0.005)

ARSENIC CONCENTRATION IN GROUNDWATER OR SURFACE WATER, IN mg/l

GROUNDWATER CONTOURS ESTIMATED FROM NUMERICAL FLOW MODEL (CALIBRATED TO ACTUAL GROUNDWATER LEVELS)

INFERRED GROUNDWATER FLOW DIRECTION

INTERPRETIVE LIMITS OF SOLID WASTE

APPROXIMATE LOCATION OF PROPERTY LINES

PAVED ROAD

UNPAVED ROAD

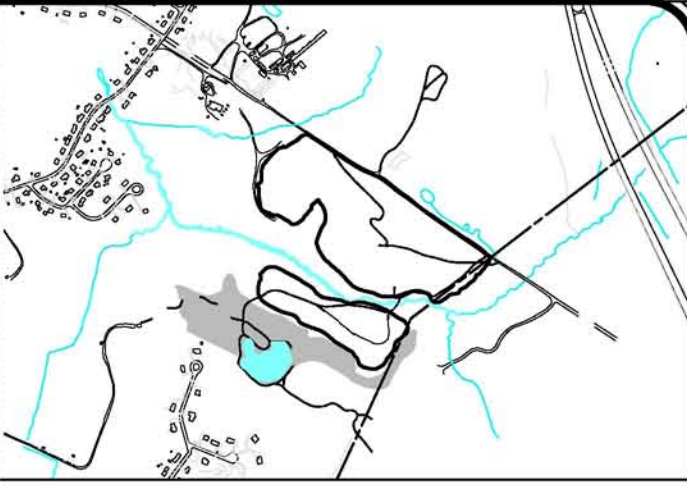
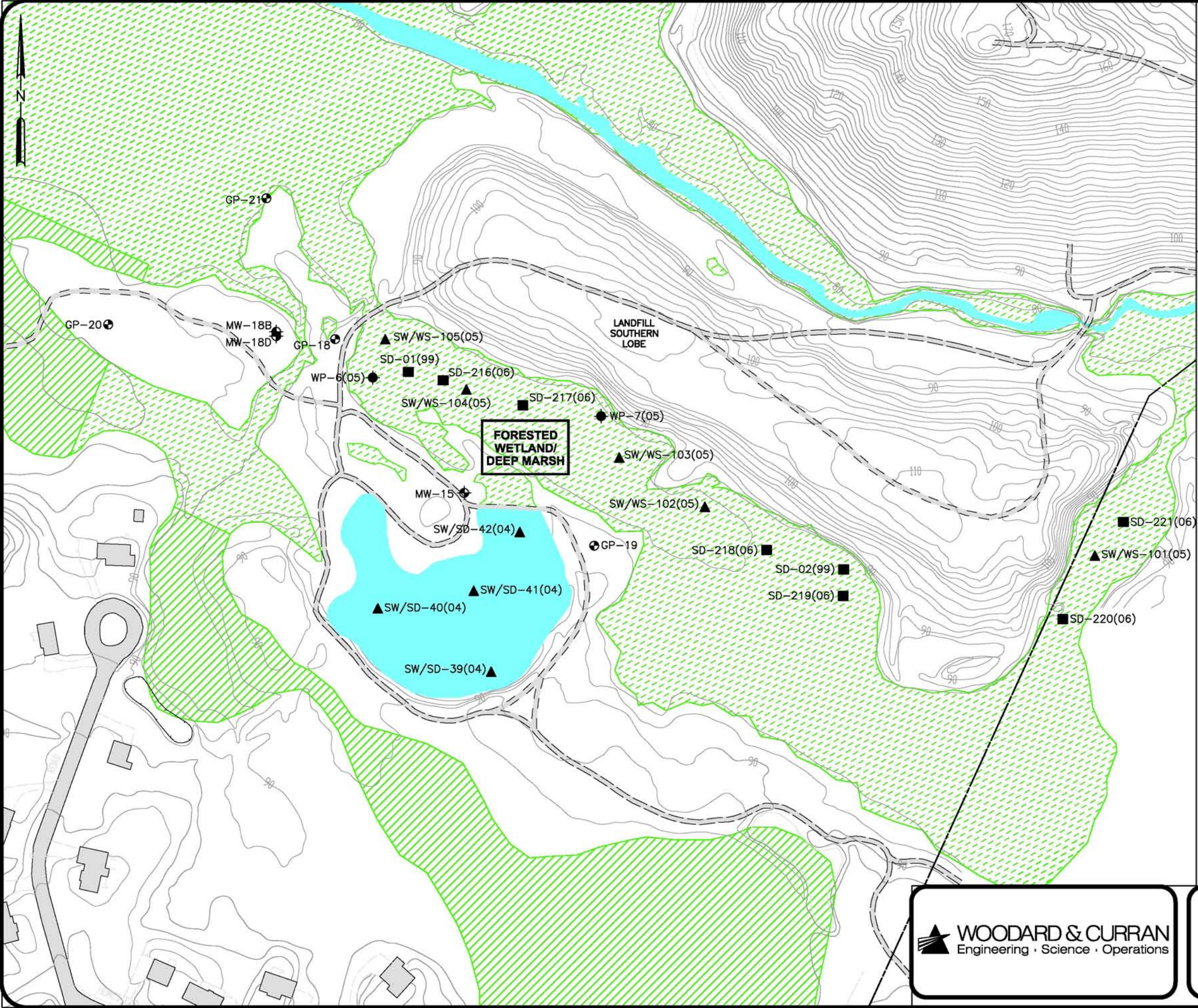
WATER

DRIVEWAY

FENCE

BUILDING

IMAGE Files: <No Images>
XREF Files: ANSBB-01.dwg
\\Andover\projects\210517 Sutton Brook wip\Drawings\RI 2-07\Section 5\ANSBF-11.dwg
Dimstyle: 1 Ltscale: 1 Ps1tscale: 1
Softdesk Project: <none>



LEGEND

MW-6 ● MONITORING WELL LOCATION AND IDENTIFIER (1995, 1999, 2001, 2003, 2004, 2005)

WP-6 ● STREAM PIEZOMETER LOCATION AND IDENTIFIER (1999, 2001, 2004, 2005)

GP-1 ● TEMPORARY WELL LOCATION AND IDENTIFIER (W&C 2004)

SS-1 ● SOIL SAMPLING LOCATION (NUS/FIT - OCT. 1989) (START - 1999) (WESTON - 2000) (WESTON - 2000 CONFIRMATORY POST- EXCAVATION LOCATIONS SENT TO LAB - DRUM DISPOSAL AREA) (W&C 2004)

SW/SD-33 ▲ SURFACE WATER AND SEDIMENT SAMPLING LOCATION (METCALF & EDDY - 1995) (START - 1999) (W&C 2004, 2005)

SD-23 ■ SEDIMENT OR AQUATIC WETLAND SAMPLING LOCATION (NUS/FIT - OCT. 1989) (START - 1999) (M&E - 1995) (W&C 2004, 2005, 2006)

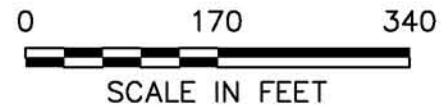
(99) - INDICATES SAMPLE YEAR FOR ONE-TIME SAMPLING EVENTS (APPLIES TO ALL MEDIA SAMPLED, EXCLUDING GROUNDWATER SAMPLES COLLECTED FROM PERMANENT MONITORING WELLS)

WETLAND BOUNDARY DELINEATED IN ACCORDANCE WITH US ACOE 1987 METHODS

WETLAND AREA DELINEATED BY AERIAL PHOTOGRAPH INTERPRETATION

UNPAVED ROAD PAVED ROAD

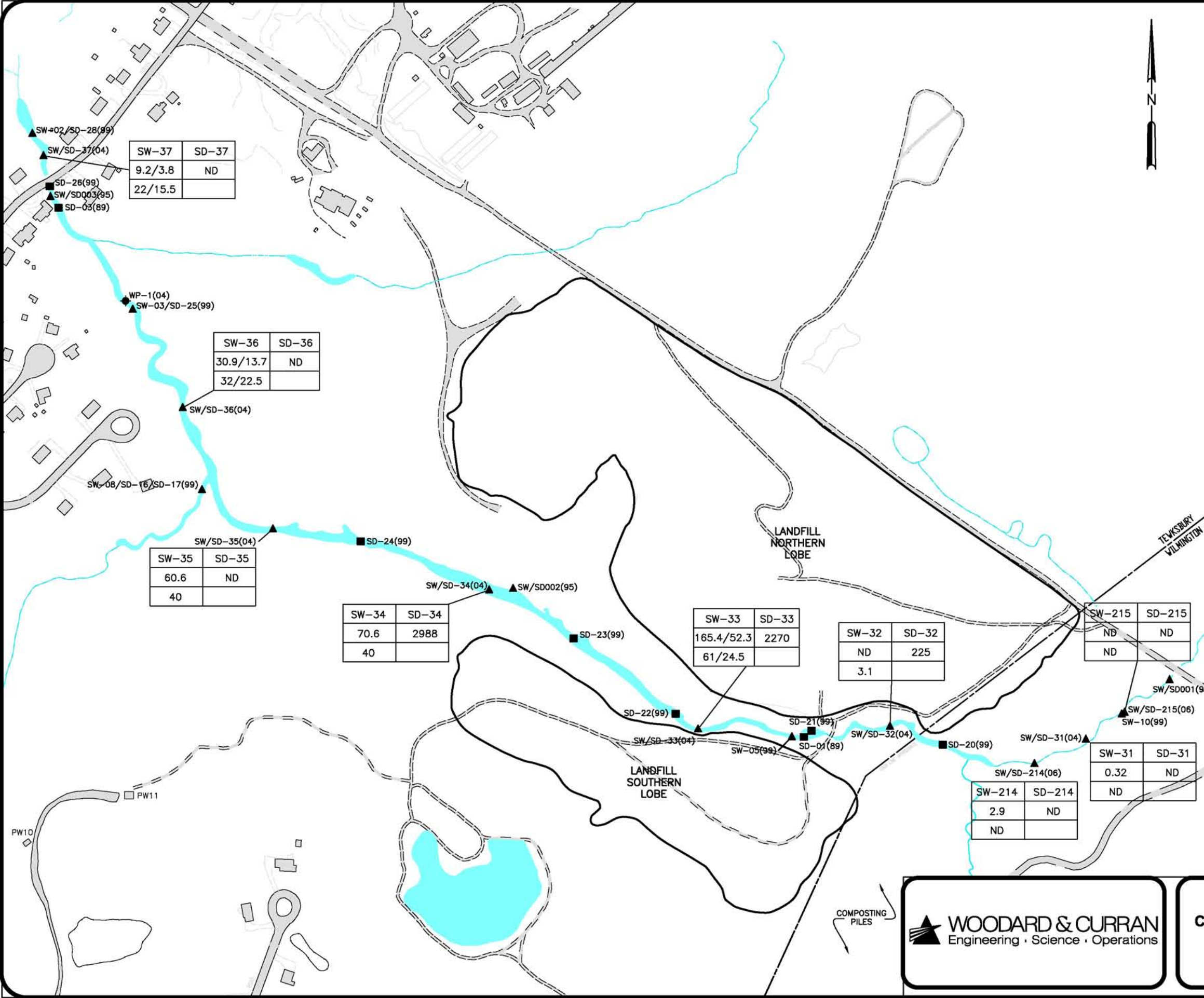
WATER BUILDING



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FIGURE 5-4e
AREA SOUTH OF SOUTHERN LOBE
SUTTON BROOK DISPOSAL AREA

IMAGE Files: <No Images>
XREF Files: ANSBB-01.dwg
\\Andover\projects\210517 Sutton Brook\wp\Drawings\RI 2-07\Section 5\ANSBF-18.dwg
Software Project: <none>
Dimstyle: 1 Ltstyle: 1 Psittscale: 1



LEGEND

▲ SURFACE WATER AND SEDIMENT SAMPLING LOCATION (METCALF & EDDY - 1995) (START - 1999) (W&C 2004, 2005)

■ SEDIMENT OR AQUATIC WETLAND SAMPLING LOCATION (NUS/FIT - OCT. 1989) (START - 1999) (M&E - 1995) (W&C 2004, 2005)

(99) - INDICATES SAMPLE YEAR FOR ONE-TIME SAMPLING EVENTS (APPLIES TO ALL MEDIA SAMPLED, EXCLUDING GROUNDWATER SAMPLES COLLECTED FROM PERMANENT MONITORING WELLS)

--- UNPAVED ROAD ——— PAVED ROAD

— WATER □ BUILDING

SURFACE WATER	SEDIMENT
SAMPLE NO.	SAMPLE NO.
TOTAL PURGEABLE AROMATIC HYDROCARBONS	TOTAL XYLENE
TETRAHYDROFURAN	

TOTAL PURGEABLE AROMATIC HYDROCARBONS

1,2,4-TRIMETHYLBENZENE, 1,3,5-TRIMETHYLBENZENE, BENZENE, ETHYLBENZENE, ISOPROPYLBENZENE, N-BUTYLBENZENE, N-PROPYLBENZENE, XYLENES, TOLUENE

CONCENTRATION = MICROGRAMS PER LITER (ug/l)
FOR SURFACE WATER

MILLIGRAMS PER KILOGRAM (mg/kg)
FOR SEDIMENT

ND = NOT DETECTED

SAMPLES REPRESENTED BY ONE DATA POINT WERE COLLECTED IN 2004 OR 2006 (SW/SD-214 AND SW/SD-215). SAMPLES COLLECTED DURING PRE-ROD MONITORING (SW-33, SW-36, AND SW-37) ARE REPRESENTED HERE BY THE MAXIMUM/AVERAGE CONCENTRATIONS MEASURED AT THOSE LOCATIONS FROM 2004-2006.

0 300 600
SCALE IN FEET

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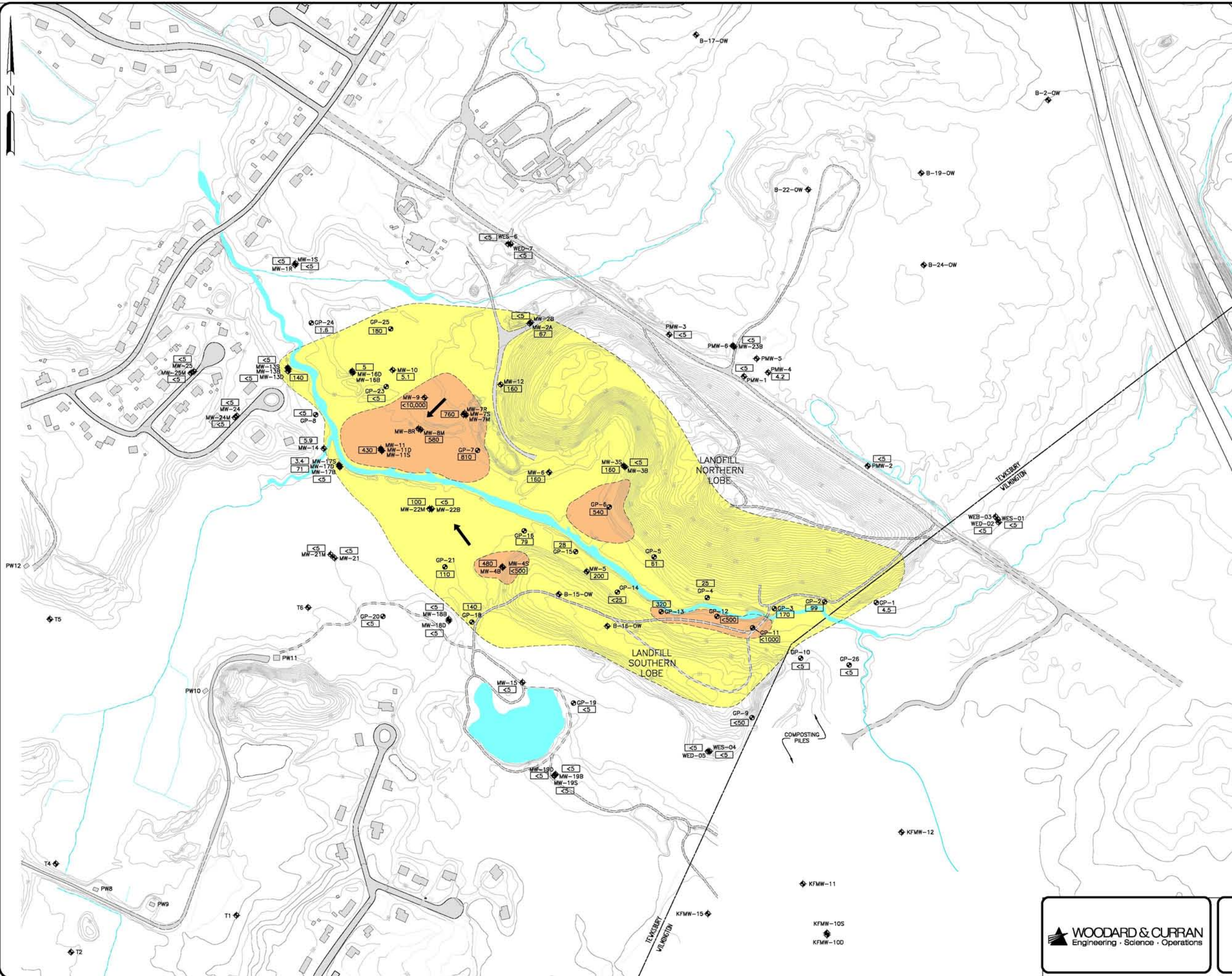
FIGURE 5-4f

CONTAMINANT PROFILE IN SUTTON BROOK

SURFACE WATER AND SEDIMENT

SUTTON BROOK DISPOSAL AREA

\\woodard\projects\110117 Sutton Brook\GIS\Drawings\110117-14.dwg
Sutton Brook Disposal Area
Date: 11/16/2006
User: jcurran



LEGEND

MW-6 MONITORING WELL LOCATION AND IDENTIFIER

GP-1 TEMPORARY WELL LOCATION AND IDENTIFIER

760 TOTAL CONCENTRATION OF 1,4 DIOXANE IN GROUNDWATER, ug/L
OCTOBER - DECEMBER 2004, EXCEPT PMW-2 (JANUARY 2005),
MW-22M/22B (MARCH 2005), MW-24/24M AND MW-25/25M
(DECEMBER 2005), AND PMW-4 (NOVEMBER 2006)

CONCENTRATION OF 1,4 DIOXANE

>300 ug/L

5 TO 299 ug/L

GENERAL DIRECTION OF OVERBURDEN GROUNDWATER FLOW
DECEMBER 16, 2004.

PAVED ROAD

UNPAVED ROAD

WATER

DRIVEWAY

FENCE

BUILDING

NOTES:

1. THE TOPOGRAPHIC AND PLANIMETRIC FEATURES AS SHOWN PROVIDED BY THE TOWN OF TEWKSBURY, MASSACHUSETTS, DEPARTMENT OF PUBLIC WORKS, AND ARE BASED UPON AERIAL PHOTOGRAMMETRIC MAPPING COMPLETED BY JAMES W. SEWALL COMPANY OF OLD TOWN, MAINE FROM AERIAL PHOTOGRAPHS DATED MARCH 29, 1985. THE MAP IS REPORTED TO MEET NATIONAL MAP ACCURACY STANDARDS FOR 1"=100' MAPS WITH 2 FOOT CONTOURS. WOODARD & CURRAN HAS NOT FIELD VERIFIED AND IS NOT RESPONSIBLE FOR ACCURACY OF SAME.

2. THE GROUND SURFACE TOPOGRAPHIC VERTICAL DATUM REFERENCED IS EXPRESSED IN FEET AND BASED UPON THE USGS NORTH AMERICAN VERTICAL DATUM OF 1929 (NAVD29), AS ESTABLISHED BY OTHERS.

3. THE SURVEY DATA AS PRESENTED ON THIS PLAN WAS CORRECT AT THE TIME THIS PLAN WAS PRODUCED. ANY AND ALL DATA IS SUBJECT TO CHANGE WITH TIME AND WE ASSUME NO RESPONSIBILITY FOR THE USE OF INCORRECT OR OUTDATED INFORMATION. FOR VERIFICATION OR UPDATE OF SURVEY DATA FOR THIS SITE CONTACT WOODARD & CURRAN. WOODARD & CURRAN HAS NOT CONDUCTED PROPERTY BOUNDARY OR EASEMENT SURVEYS.

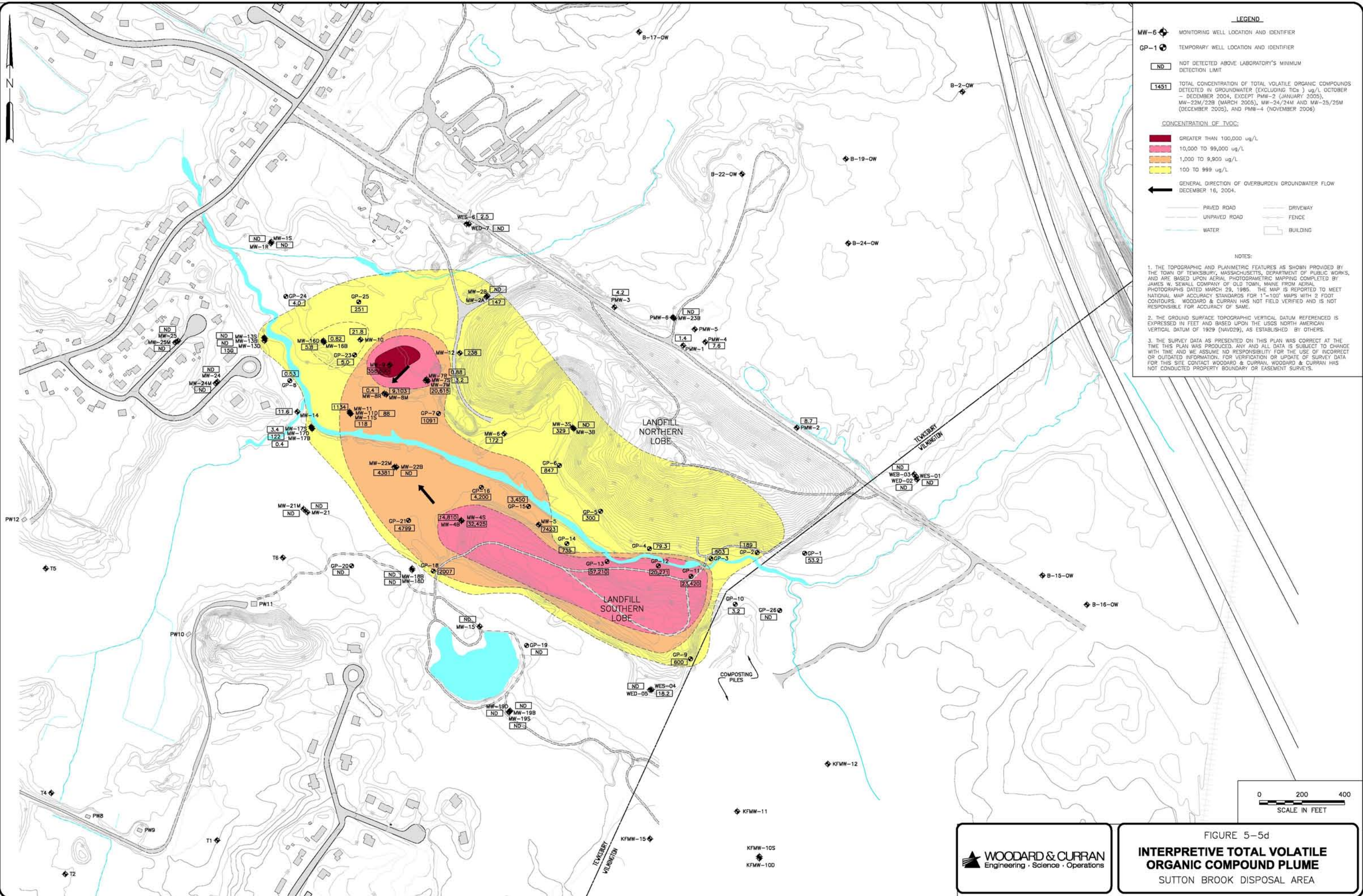
WOODARD & CURRAN
Engineering • Science • Operations

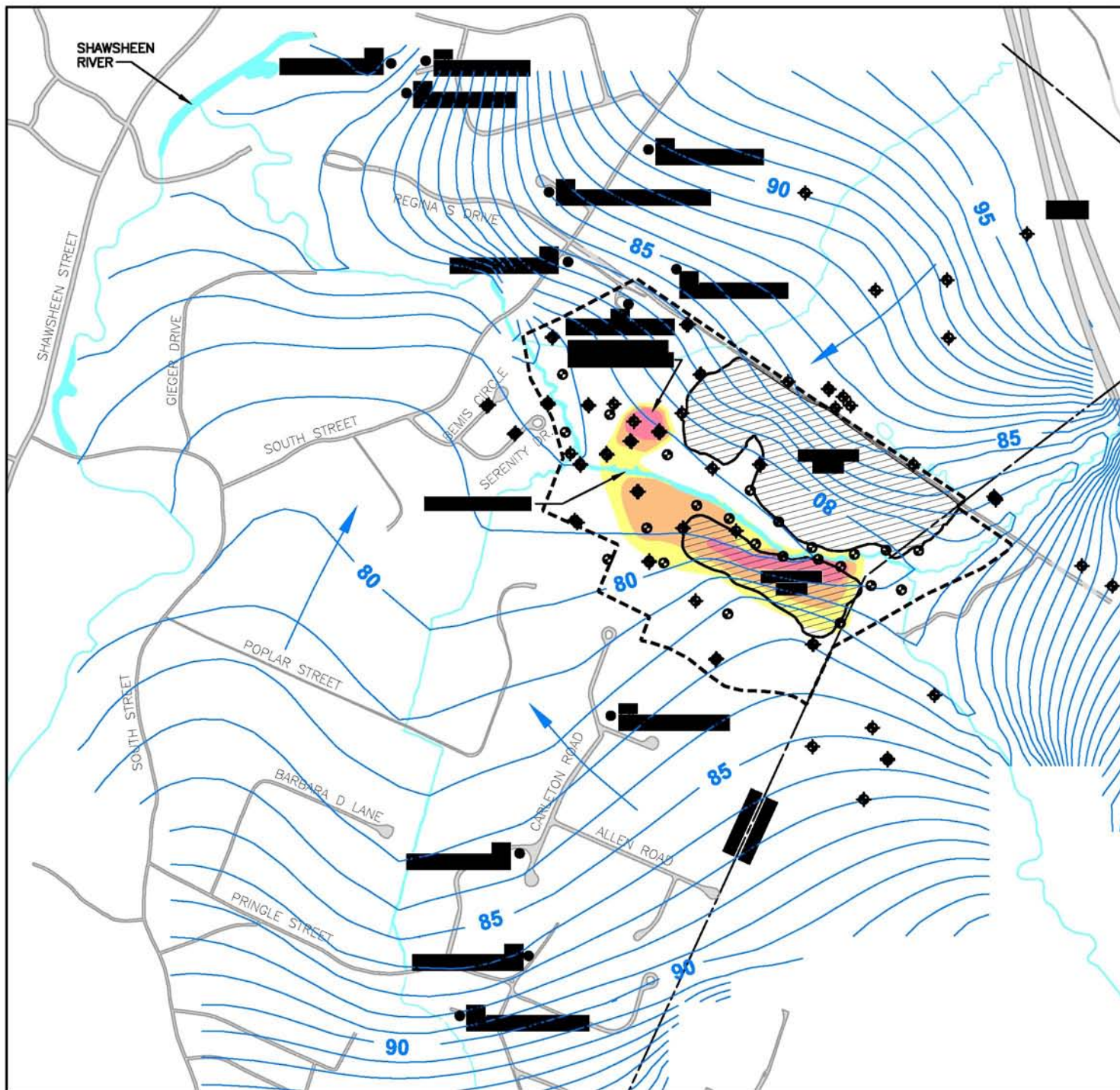
FIGURE 5-5c

INTERPRETIVE 1,4 DIOXANE PLUME

SUTTON BROOK DISPOSAL AREA

\\woodard\projects\101017 Sutton Brook\GIS\Drawings\101017-1.dwg
DATE: 11/11/05
TIME: 11:00 AM
USER: woodard
PLOT: 11/11/05





LEGEND

----- RI AREA

PW ● PRIVATE WELL USED FOR DRINKING OR IRRIGATION PURPOSES

◆ MONITORING WELL LOCATION

⊙ TEMPORARY WELL LOCATION

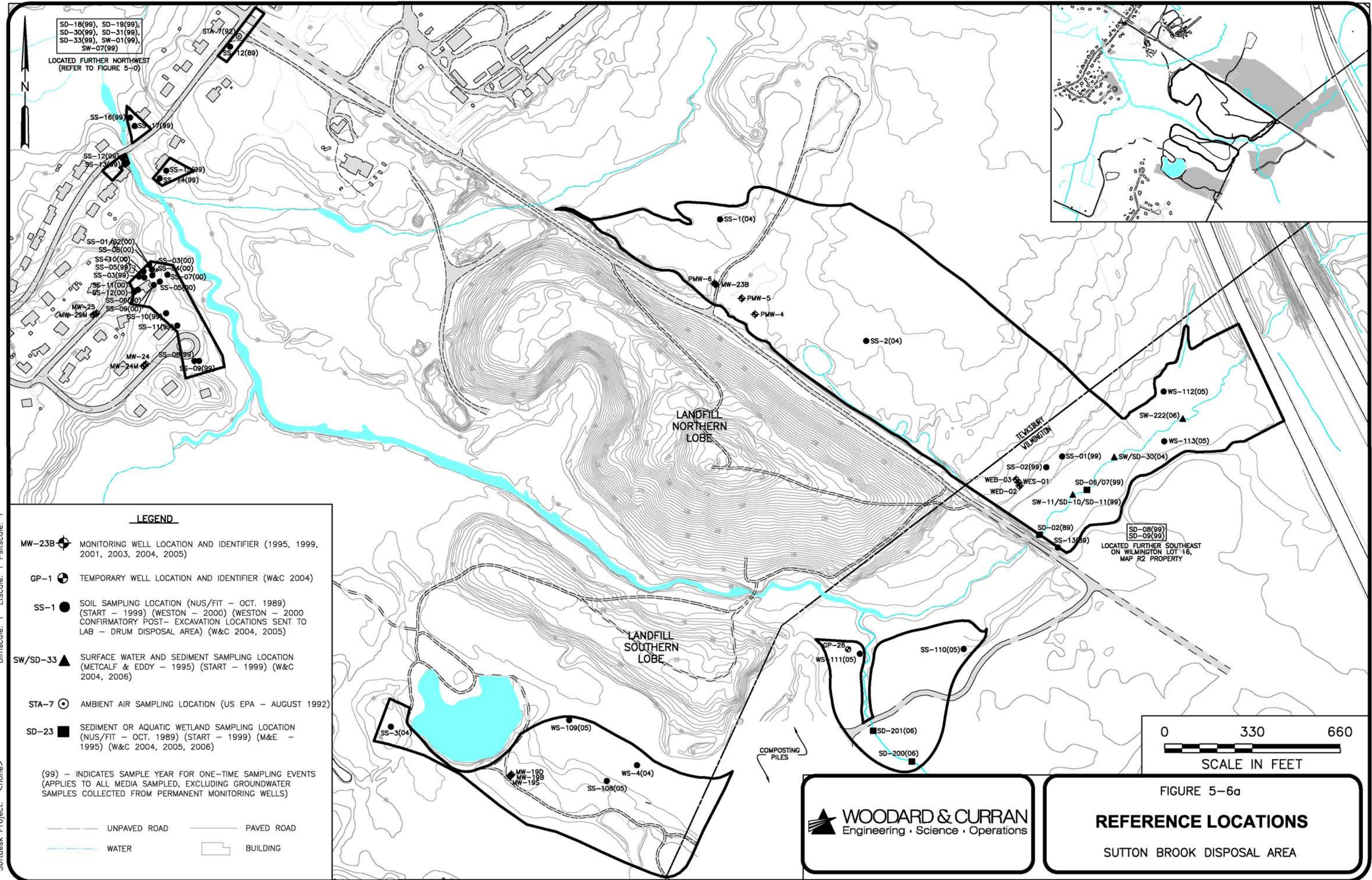
80 ——— SIMULATED POTENTIOMETRIC SURFACE FROM GROUNDWATER FLOW MODEL (W&C, 2006)

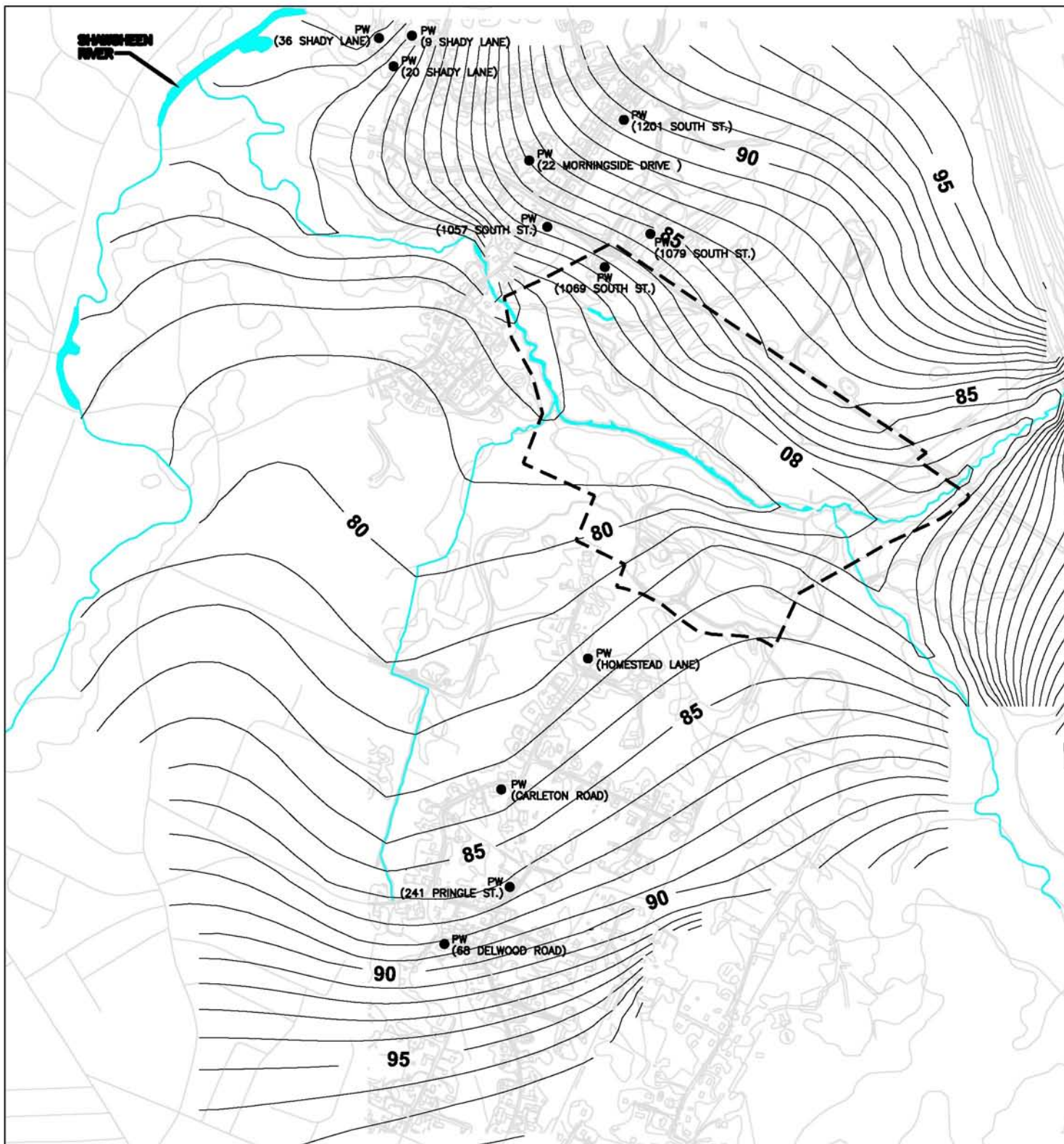
➡ INFERRED GROUNDWATER FLOW DIRECTION

▨ INTERPRETIVE LIMITS OF SOLID WASTE

INTERPRETIVE PURGEABLE AROMATIC HYDROCARBON PLUME (REFER TO FIGURE 5-5a)

IMAGE Files: <No Images>
XREF Files: ANSBB-01.dwg
\\Andover\projects\210517 Sutton Brook\wp\Drawings\RI 2-07\Section 5\ANSBF-21.dwg
Dimstyle: 1 Ltscale: 1 Psittscale: 1
Softdesk Project: <none>





LEGEND

--- RI AREA

PW ● PRIVATE WELL USED FOR DRINKING OR IRRIGATION PURPOSES (NOT ALL ACTIVE)

80 — SIMULATED POTENTIOMETRIC SURFACE FROM GROUNDWATER FLOW MODEL (W&C, 2006)



6. CONTAMINANT FATE AND TRANSPORT

This section provides information on general fate and transport processes relevant to potential human and ecological exposures and specific fate and transport information relevant to the contaminants identified at the Site.

Fate and transport processes affect how chemicals behave in the natural environment and move from source areas to potential human and environmental receptors. A number of important physical and chemical processes affect contaminant fate and transport including: 1) wind and stream flow/water movement; 2) chemical-specific factors affecting partitioning between solid and dissolved phases; 3) interactions between the dissolved and particulate phase of each compound (or compound group) within each media; and 4) chemical partitioning or transformation within each media.

Based on the results of the investigation and data evaluation presented in Section 5, the predominant contaminant class detected across the site was VOCs, followed by metals and SVOCs. An evaluation of the fate and transport of these general classes of contaminants is presented in this section. For data presentation purposes this fate and transport discussion has been divided into the following sections.

- Fate and Transport Processes and Pathways (Section 6.1) – this section provides a general discussion of fate and transport pathways/processes and the properties relating to subsurface materials, site conditions, and contaminants identified during the investigation.
- Site-Specific Contaminant Persistence in the Environment (Section 6.2) – this section provides a contaminant specific discussion on the physical and chemical processes that affect chemical persistence in the environment.
- Site-Specific Contaminant Migration (Section 6.3) – this section presents a site specific assessment of the primary contaminant migration pathways.

6.1 FATE AND TRANSPORT PROCESSES AND PATHWAYS

A summary of the fate and transport processes/pathways identified for the site is presented on Table 6-1. This table also indicates properties of the subsurface materials, site conditions, and contaminants that relate to each of these fate and transport processes/pathways. A general discussion of the fate and transport processes/pathways identified on Table 6-1, including the specific data collected to evaluate these processes/pathways, is presented in the following sections.

6.1.1 Leaching from Soils and Waste to Groundwater

Contaminant leaching refers to the movement of a contaminant downward through the soil or waste column (for both the northern and southern landfill lobes) to the underlying groundwater. Many factors affect whether or not a contaminant leaches, including: solubility, biodegradation, hydrolysis, dissociation, sorption, volatility, rainfall, and evapo-transpiration (Ney, 1990).

A site-specific condition that plays a significant role in contaminant leaching is the amount of water available to percolate through the soil and/or waste column (infiltration). Since the entire site is uncovered (with the exception of buildings located in the residence/garage area), the uncapped/uncontained nature of the site, including the landfill, does not limit infiltration and subsequent leaching.

As discussed in Section 5.1, visible leachate outbreaks were evident along the slopes of the hydraulically downgradient edges of both the landfill lobes. In addition, higher concentrations of contaminants were detected in groundwater immediately downgradient from the site source areas. This evidence supports that leaching from the soils and waste to groundwater is occurring at the Site.



To aid in evaluating the leaching of the contaminants in soil, several characteristics of the soil were evaluated. These characteristics included: contaminant concentrations, pH, organic matter, cation exchange capacity, hydraulic conductivity, surface area, and leachability. In addition, physicochemical properties of the specific contaminants were also evaluated (i.e., sorption, solubility, etc.). A general discussion of these properties is provided in Section 6.1.5.

6.1.2 Volatilization to Ambient Air

The extent to which an organic chemical can volatilize from soil and water depends on its vapor pressure, aqueous solubility, and air diffusion coefficient. The vapor pressure is a measurement of the concentration of a compound in air in equilibrium with the compound in its pure liquid or solid state and provides a general indication of a compound's volatility.

The air diffusion coefficient determines how quickly a compound moves from the bulk fluid to the air-water interface, where it can volatilize. The Henry's Law constant (K_H), which is the partition coefficient that expresses the ratio of the chemical concentration in air to that in water at equilibrium, is used to estimate the transfer of a compound between water and air. It is often calculated as the ratio of a compound's vapor pressure to its aqueous solubility. In general, organic compounds with K_H values greater than 10^{-3} atmosphere-cubic meters per mole ($\text{atm}\cdot\text{m}^3/\text{mol}$) can be expected to volatilize readily from water, whereas compounds with K_H values less than 10^{-5} $\text{atm}\cdot\text{m}^3/\text{mol}$ volatilize from water only to a limited extent (Lyman et al., 1990).

Once volatilized into the soil gas, compounds migrate through the unsaturated zone and are subject to the same forces which govern advection and dispersion in groundwater (e.g., soil permeability, mechanical mixing, etc.). Contaminant transport in the unsaturated zone is subject to molecular diffusion, gravitational effects, and air flows. Air flows can be generated by changes in barometric pressure, disturbances to groundwater or the subsurface, or the displacement of soil gas by the infiltration of groundwater. Generally, organic compounds in the vapor phase are heavier than air, therefore, their migration to the surface is slowed by gravitational effects.

In addition to the physicochemical properties of the organic compounds (i.e., Henry's Law Constants, vapor pressure, etc.), data collected/evaluated as part of the site investigation included: soil gas samples from points located within the confines of the landfill lobes; ambient air samples; and contaminant concentrations in shallow groundwater. Ambient air samples were collected from stations on the landfill lobes as well as further away onto South Street and analyzed for VOCs. The results indicated that concentrations of several VOCs were present in the samples collected on the landfill, but these concentrations were low and generally consistent with published reference ambient air concentrations. No VOCs were detected in samples collected away from the landfill.

6.1.3 Migration with Groundwater Flow

The principal processes related to contaminant migration with bulk groundwater flow are considered to be advection and dispersion. Other properties of the contaminant (i.e., sorption, solubility, etc.) also play a role and are discussed collectively in Section 6.1.5.

Advection

Once a compound becomes dissolved in groundwater, advection is the dominant factor affecting its migration through porous media. Advection is the process by which a dissolved compound is transported by the bulk motion of groundwater flow. The groundwater flow velocity through the aquifer determines the maximum rate at which a dissolved compound can migrate.

Variations in hydraulic conductivity and hydraulic gradients within the aquifer will result in differing advection rates for the dissolved compounds. These variations in advection rates result in horizontal and



vertical dispersion of the compounds as they move within the aquifer (see discussion of dispersion below).

Aquifer heterogeneity and subsequent variability in hydraulic conductivity have a direct influence on groundwater seepage velocity and thus contaminant migration in the saturated zone. In addition, the presence and orientation of fracture patterns in bedrock also have a significant effect on contaminant migration in bedrock.

Dispersion

The process of dispersion is the result of mechanical mixing and molecular diffusion. Molecular diffusion is governed by a compound's diffusivity in water and its chemical concentration gradient. Mechanical mixing results from variations in groundwater flow velocity due to frictional forces and variations in soil pore geometry and aquifer dispersivity.

The result of dispersion is the spreading of dissolved constituents over a greater extent of the aquifer than would be predicted solely by quantifying advective flows. Dispersion causes a decrease in the compound concentrations within the groundwater plume due to mixing with "uncontaminated" groundwater. The result is a wider spread and more dilute contaminant plume than would be caused by strictly laminar groundwater flow.

Dispersion parallel to the direction of groundwater flow (e.g., longitudinal dispersivity) is the strongest component of dispersion, while dispersion transverse to the direction of flow and in the vertical direction is generally small. Therefore, wide aerial or vertical spreading of dissolved compounds in groundwater due to dispersion is not expected to occur.

To aid in evaluating contaminant migration with groundwater flow, the following data was collected: water level measurements from monitoring wells and stream piezometers; single well response tests to determine hydraulic conductivity and geologic logging of the different saturated materials. A detailed discussion of groundwater flow patterns, hydraulic conductivity measurements and estimated seepage velocities for saturated units was previously presented in Section 4.

In summary, groundwater generally flows away from the Northern and Southern lobes of the Landfill toward Sutton Brook. Downward gradients were observed in overburden wells away from the brook with upward gradients in the overburden (deep to shallow) and into the wetlands with proximity to Sutton Brook.

6.1.4 Discharge from Groundwater to Surface Water and Migration with Surface Water

Once a substance becomes dissolved in groundwater, it may migrate from the source area through the aquifer and may potentially discharge to a surface water body. The amount of groundwater discharging to the brook (and tributaries) from the site is dependent upon the hydraulic conductivity of overburden materials (fill, organic silt), the hydraulic gradients near the brook/wetlands, and the cross sectional area of these units adjacent to the brook.

As presented in Section 4.3, the overburden hydraulic conductivities range from 0.9 to 58 ft/day at the Site. The large range in conductivity is directly related to the differences in hydraulic gradient and soil type across the site. Estimated seepage velocities range from 4 to 14 feet per year in the intermediate/deep overburden (areas of higher contaminant concentrations) to 130 to 400 feet per year in the shallow water table soils. These estimated velocities are considered an approximation of the movement of groundwater and possible selective conservative compounds within the specific geologic units and not necessarily indicative of the rate of contaminant transport. Factors that cause dissolved compounds to move more slowly than groundwater and which are discussed below include biological and chemical degradation (e.g., chemical transformation or breakdown), precipitation reactions (e.g.,



dissolved chemical precipitating out of solution as relatively insoluble compounds), and sorption of dissolved chemicals to soil.

Given the hydraulic conductivity differences, a component of groundwater flow most likely discharges to Sutton Brook and its associated tributaries and wetland areas, immediately downgradient of the source areas. This finding is supported by the detection of contaminants in surface water, sediments, shallow groundwater beneath the wetlands and passive vapor diffusion samples in the sediments.

6.1.5 Non-Biological Processes

The principal non-biological processes related to a contaminant's fate and transport in the environment include: sorption; ion exchange; hydrolysis; photolysis; speciation (dissolution, weathering, and precipitation); and oxidation-reduction reactions. A general discussion of each of these processes is presented in the following paragraphs. A more detailed site-specific discussion relative to these processes and their significance with respect to the specific contaminant classes is presented in Section 6.2.

Sorption

Sorption influences several transport mechanisms and transformation reactions including, advection, rates of volatilization, photolysis, hydrolysis, and biodegradation. Physical and chemical parameters which are indicative of a compound's tendency to sorb to soil include its aqueous solubility, octanol-water partition coefficient (K_{ow}), and organic carbon partition coefficient (K_{oc}).

The K_{ow} of a compound is the ratio of the concentration of the chemical dissolved in octanol to the concentration of the chemical dissolved in water as measured in a standard laboratory test of the chemical's partitioning behavior. The value is usually expressed as $\log(K_{ow})$. Compounds with a lower $\log(K_{ow})$ (i.e., less than 2.7 [Ney, 1995]) indicate a greater tendency to dissolve in water rather than be sorbed to soils; whereas, a higher $\log(K_{ow})$ value (i.e., greater than 3 [Ney, 1995]) indicate compounds that have a greater tendency to be sorbed to soils than dissolved in water.

The K_{oc} of a compound is the ratio of adsorbed chemical per unit weight of organic carbon in solution to the dissolved concentration of the chemical. The value provides a more direct measurement of the tendency of a chemical to partition into organic carbon than the K_{ow} measurement and is used widely in modeling chemical fate and transport. In practice, however, $\log(K_{oc})$ is usually calculated from $\log(K_{ow})$. The higher the K_{oc} value, the greater the chemical's tendency to sorb to soil organic matter rather than migrating with bulk groundwater flow. In general, compounds with $\log(K_{oc})$ values greater than four tend to sorb strongly to soil organic carbon.

In general, the more water soluble organic compounds have a tendency to dissolve in groundwater and migrate with the bulk motion of groundwater flow. In contrast, the less water soluble organic compounds tend to sorb onto the aquifer material and have their rate of transport retarded. Compounds with a high solubility are more likely to be found at the leading edge of a plume, because their mobility is greater than the less soluble compounds.

Ion Exchange

Ion exchange is a specific component of adsorption. The adsorption described in the preceding section relates to sorption of neutral organic chemicals accumulating in the fraction organic content of the media. Ion exchange relates to sorption due to the affinity of the solid surface for the chemical. In subsurface media, the mineral fraction most commonly involved in ion exchange is the clay fraction. Soil surfaces are generally negatively charged which would tend to attract and accumulate cations. The cations most commonly participating in ion exchange processes are inorganic elements or compounds.

The surface charge of many mineral surfaces is a function of pH. The mineral surface can exhibit a positive charge at low pH and a negative charge at high pH. Two significant processes with respect to ion exchange are the level of adsorption and the rate at which the exchange occurs. The cation exchange



capacity (CEC) refers to the total amount of cations absorbed by the negative charged soil surfaces on a unit mass of soil. The CEC generally increases with the amount of finer materials.

Hydrolysis

Hydrolysis involves the chemical reaction between a dissolved compound and water, hydrogen ions or hydroxyl ions. In this reaction, either the hydroxyl ion or a hydrogen ion replaces part of the compound forming a degradation product that is more water soluble.

Photolysis

Photolysis is the process whereby a compound undergoes a chemical transformation due to the input of solar energy to a system. Photolysis occurs as a result of the compound absorbing enough light energy to trigger a transformation reaction. Compounds with aromatic ring structures or double bonds have the potential to undergo photolysis reactions.

Speciation: Dissolution, Weathering, and Precipitation

Dissolution refers to the solubilizing of all components of a compound or mineral. Weathering is the partial solubilization of certain elements within the mineral or chemical, leaving behind other elements. Precipitation, which is the opposite of dissolution, refers to when the saturation limit of a chemical becomes exceeded, resulting in a precipitation of the chemical. This may result from a change in environmental conditions (pH, redox potential, temperature, etc.).

Oxidation/Reduction Reactions

Oxidation refers to the loss of electrons and reduction refers to the gain of electrons. The ability of an oxidation-reduction reaction to occur is a function of the oxidation-reduction potential (or redox). Chemical elements most commonly impacted by redox reactions are C, N, O, S, Mn, and Fe and those that are susceptible to redox reactions include As, Se, Cr, Hg, and Pb (Knox, 1993). Groundwater across the majority of the Site was observed to be under reducing conditions.

Chemical oxidation can occur when a compound reacts with an oxidizer. Naturally occurring oxidizers are most often produced as a result of a photolytic transformation (see photolysis above). Oxidizers, because of their reactive nature, are not very stable; therefore, for chemical oxidation to be a significant process, oxidizers must be continually produced, as occurs in surface waters due to photolysis. Chemical transformations due to reaction with a photolytic byproduct are often referred to as indirect photolysis. Transformations due to photochemical oxidation generally do not occur in groundwater because of the absence of light.

6.1.6 Biological Processes

Biological Degradation

Biodegradation of organic compounds is often one of the more important fate processes resulting in their removal from a subsurface environment. Microbes gain energy by promoting chemical oxidation, hydrolysis, or substitution reactions in the organic compound. The resulting product is generally more water soluble and often more readily degraded than the parent compound.

The primary environment for biological degradation is in groundwater, because it provides a transport media for the microbes and the chemicals, which act as their energy source, to come into contact. Microbial activity can be aerobic (requiring oxygen) or anaerobic (occurring in the absence of oxygen). Aerobic degradation in the subsurface is often limited by the availability of oxygen to the microbes. Thus, compounds which otherwise might readily biodegrade can persist in the environment due to limits on oxygen transfer. Another limitation on biodegradation in the subsurface is nutrient availability. Like oxygen, in the isolated environment of the subsurface, nutrients are often exhausted by microbes that are degrading organic compounds.



Bioaccumulation

Some compounds, because of their hydrophobicity, have the potential to accumulate in the fatty cells of organisms. Given the site conditions, such organisms identified at the site are predominantly associated with Sutton Brook and the associated tributaries and wetland areas. Contaminants in Sutton Brook may be bioaccumulated (taken up and retained from food, sediment and water) and/or bioconcentrated (taken up and retained from water) in fish and other aquatic organisms.

The rates of bioaccumulation/bioconcentration and depuration (chemical loss in an organism) can be affected by numerous factors including the physical and chemical properties of the chemical, the physiology and biology of the organism, environmental conditions, ecological factors such as habitat and food web structure, and the amount and source of the chemical. For constant chemical exposure, the time required to achieve steady-state (when rates of uptake and depuration are equal) varies according to chemical properties, such as the hydrophobic/hydrophilic nature of the chemical and sorption of nonpolar organic chemicals by sediments.

When compounds are concentrated in a system where they can be absorbed by the lower trophic levels of a food chain, the potential for biomagnification occurs (as the organisms which feed on many of these lower trophic level species absorb and retain their bodily burden of the compound). Although ambient concentrations of certain chemicals in the environment may be too low to affect the lowest level organism, the biomagnification process can result in concentrations which may pose health risks to the consumer of the top trophic levels.

In general, the predominant contaminants detected at the site do not have a tendency to bioaccumulate. However, a full evaluation of the contaminants detected at the site, as it pertains to potential receptors and exposure points, is presented in the Section 7.0 (Risk Assessment).

Potential for Uptake by Plants

Plants can incorporate chemicals in the soil via the root systems or by uptake of volatile chemicals or chemicals resulting from atmospheric deposition in the leaves. The ability of a plant to sorb contaminants from the soil is based upon the chemical's concentrations and physicochemical properties, the organic carbon content and the grain size of the soil, and the metabolic and physical characteristics of the plant species. Chemical-specific characteristics/properties that may indicate relative ability to be taken up and bioconcentrated in plants include the chemical's molecular weight, sorption coefficient, vapor pressure, and bioconcentration factor for plants. In general, the larger the molecular weight of the chemical, the less likely the plant is able to mobilize the chemical from the soil and incorporate into the plant tissue.

For organic chemicals, the bioconcentration factor from soil through roots to above ground produce is directly related to the chemical's water solubility, which is inversely proportional to the octanol-water partitioning coefficient. For inorganics, the plant bioconcentration factor is a function of the sorption coefficient (K_{oc}), which indicates the chemicals potential to bind to organic carbon in soil, thereby making the chemical less likely to be available for plant uptake (limiting bioavailability). For a limited number of chemicals and plants, empirical studies have yielded bioconcentration factors (plant uptake factors for contaminants in soil), indicating the degree a specific plant species is able to incorporate a single chemical into its tissue.

6.1.7 Wind-Blown and Stormwater Run-off

Contaminant transport via wind or storm water run-off may be significant pathways in uncovered or unpaved areas with contaminated surface soils. Contaminants in soil or as vapors/gases may be transported via wind and deposited elsewhere on the site or via surface run-off and discharged elsewhere on the site or to the brook and/or associated tributaries. As indicated previously, the majority of the site is not paved, although a significant portion of the site is vegetated including the landfill lobes, which will reduce run-off. Non-vegetated areas such as portions of the residence/garage area have the highest



potential for surface run-off and entrainment of contaminated dust into air. These features limit the amount of contaminant transport via these pathways (although some transport could occur in unpaved areas, if contaminated).

6.2 SITE-SPECIFIC CONTAMINANT PERSISTENCE IN THE ENVIRONMENT

Persistence is the measure of how long a contaminant will exist in the environment before it degrades or transforms (physically or chemically) into another chemical. The primary physical and chemical processes that may affect contaminant persistence at the site include: aqueous solubility, advection, dispersion, sorption, volatilization, chemical degradation (i.e., hydrolysis), and biological degradation. A site-specific discussion of the physicochemical characteristics of the primary constituents detected at the site is presented in this section. As previously presented, the predominant contaminant classes detected in site media in terms of frequency of detection and concentration level are VOCs, metals and SVOCs. For discussion purposes, this section has been broken into these following contaminant classes:

- Volatile Organic Compounds
- Metals
- Semi-Volatile Organic Compounds

Each of these categories, including specific discussions on the most predominant chemicals detected at the site, is discussed below.

6.2.1 Volatile Organic Compounds

Volatile organic compounds (VOCs) are a class of compounds which exhibit significant vapor pressure under natural environmental conditions. The VOCs predominantly detected in soils or groundwater across the site are generally categorized as purgeable aromatic hydrocarbons (benzene, toluene, ethylbenzene, trimethylbenzenes and xylene), chlorinated aliphatic hydrocarbons (1,1-DCA and TCE) or ketones (4-methyl-2-pentanone and 2-butanone). Similar to soils and groundwater, the predominant constituents detected in surface water and sediments were the purgeable aromatic hydrocarbons (primarily toluene, ethylbenzene and xylenes).

A general discussion of each is presented below and a more detailed discussion on the specific physiochemical properties influencing the predominant VOC contaminants is presented in Section 6.2.1.5.

6.2.1.1 Purgeable Aromatic Hydrocarbons

The simplest organic compounds are hydrocarbons, which consist solely of carbon and hydrogen. Hydrocarbons can be divided into two classes, aromatic hydrocarbons, which contain a benzene ring, and aliphatic hydrocarbons, which do not contain a benzene ring. Aromatic hydrocarbons such as benzene, toluene, ethylbenzene, trimethylbenzenes and xylene were the most predominant VOCs detected at the Site.

The most frequently detected purgeable aromatic hydrocarbons found at the site (in soils and groundwater) include xylenes, toluene, trimethylbenzenes, and ethylbenzene. Specific to groundwater, 8 of the top 15 VOC constituents detected in groundwater were purgeable aromatics hydrocarbons. In general, purgeable aromatics are fairly mobile in soil and groundwater and if a small quantity of purgeable aromatic hydrocarbons is released, most of it is sorbed in the vadose zone and only a small fraction will be present in soil gas and soil moisture. However, if larger amounts of these contaminants were released into sandy sediments, the contaminants would migrate downward until they reached the capillary fringe above the water table. Toluene and benzene, which are lighter than water, are likely to spread laterally in the capillary fringe. Once the contaminants reach the groundwater, some of the aromatic hydrocarbons will dissolve and migrate with the flow of groundwater. Soils with moderate to



high organic carbon content also have greater potential for adsorption of the aromatic hydrocarbons. A more detailed discussion on the specific physiochemical properties influencing the predominant purgeable aromatic compounds is presented in Section 6.2.1.5.

6.2.1.2 1,4-Dioxane and Tetrahydrofuran

As presented in Section 5.5, 1,4-dioxane and tetrahydrofuran (THF) were two of the most frequently detected VOCs in groundwater and they were also generally detected at higher concentrations. 1,4-dioxane was also detected in surface water samples. No concentrations of 1,4-dioxane were detected in site soils or sediments and only low concentrations of THF were detected in soil (1 sample) and sediments (4 samples). THF was detected in 19 of the 29 surface water samples collected between October 2004 and December 2005.

1,4-Dioxane

1,4-Dioxane is a cyclic organic compound and because of its high aqueous solubility and high resistance to biodegradation, it is generally very persistent in the environment and therefore has greater potential to impact groundwater and surface water quality.

As a chemical, 1,4-dioxane is used primarily as a solvent in paints, varnishes, lacquers, cosmetics, deodorants, cleaning and detergent preparations, and in scintillating fluids. Literature searches also indicated the potential for use as a solvent in the processing of crude petroleum, petroleum refining, petrochemicals, pulp and paper, explosives, commercial printing, electroplating/polishing, pesticide and agricultural manufacture, dyes, fiber manufacture, pharmaceuticals, adhesives, semiconductors, electronic components, photographic equipment, magnetic recording media, polymers, plastics, rubber manufacture, and organic and inorganic chemical manufacture. 1,4-Dioxane often has been used with chlorinated solvents, particularly 1,1,1-trichloroethane (TCA), as a stabilizer and corrosion inhibitor.

1,4-Dioxane is highly flammable and potentially explosive if not stored properly. Since it is highly miscible in water, it can be found in groundwater plumes far in advance of any solvents with which it might have entered the subsurface with originally.

Tetrahydrofuran

Similar to 1,4-dioxane, THF is very persistent in the environment and has a high resistance to biodegradation. Tetrahydrofuran is an industrial solvent and widely recognized for its unique combination of useful properties. Uses for THF include: polyurethanes; thermoplastic polyurethanes used in coating media (magnetic tapes and synthetic leather); adhesives; PVC cements, top coating, cleaners and castings; cellophane coatings; and printing inks for plastics.

A more detailed discussion on the specific physiochemical properties influencing 1,4-dioxane's and THF's persistence in the environment is presented in Section 6.2.1.5.

6.2.1.3 Ketones

Ketones are generally classified as water clear, highly mobile liquids that are chemically very stable. Ketones are typically used in surface coatings, adhesives, thinners, printing inks, cleaning agents as well as in other industrial and pharmaceutical uses. The predominant ketones detected in area-wide groundwater were 4-methyl-2-pentanone and 2-butanone.

4-Methyl-2-Pentanone and 2-Butanone

4-Methyl-2-Pentanone (or methyl isobutyl ketone [MIBK]) is a colorless, medium boiling liquid, with a characteristic pleasant odor. It is used as a solvent in synthetic resin paints, lacquers, aircraft dopes, and varnishes. It is also a solvent for adhesives and rubber cement.



2-Butanone (or methyl ethyl ketone [MEK]) is a colorless, low viscosity liquid with a mild odor similar to that of acetone. It is completely miscible with many organic liquids, but miscible with water only to a limited extent. If 2-butanone is released to water it is expected to rapidly volatilize to the atmosphere. Based on its Henry's law constant, an estimated volatilization half-life from a model river 1 m deep, flowing at 1 m/sec with a wind velocity of 3 m/sec, is approximately 15 hours (Lyman et al. 1982).

In general, 2-butanone and 4-methyl-2-pentanone are not expected to significantly adsorb to sediment and suspended organic matter, as both compounds have a greater affinity to be dissolved in groundwater or surface water. Additional physiochemical properties are presented in Section 6.2.1.5.

6.2.1.4 Chlorinated Aliphatic Hydrocarbons

The chlorinated aliphatic hydrocarbons (CAHs) detected in soil and groundwater are predominantly represented by chlorinated ethanes (i.e., 1,1-DCA and 1,1,1-TCA) and chlorinated ethylenes (cis-1,2-dichloroethene and trichloroethene [TCE]). CAH compounds are common solvents and are generally persistent in the environment. CAHs are common contaminants in soil and in the surficial aquifer at the site, although generally detected at lower levels and below groundwater MCLs.

Most CAHs are mobile in the subsurface environment because of their physicochemical properties. They have a high vapor pressure, and volatilized CAHs are commonly found in the vadose zone of a contaminated site. Most CAHs have low water solubilities and are denser than water. If a large quantity of CAHs is released to the subsurface, the compounds may occur as free phase liquids and move downward through the ground until they encounter a low-permeability subsurface stratum. Because they are uncharged, nonionic, and nonpolar, CAHs dissolved in the aqueous phase tend to be quite mobile in aquifers that have low organic carbon contents (Barbee, 1994).

In the natural environment, CAHs can be transformed both chemically (abiotic) and biologically (biotic) (McCarty and Semprini 1993). The transformation depends on the oxidation state of the CAHs, the local groundwater chemistry, the aerobic or anaerobic conditions in the subsurface, and the presence of microbial populations. Generally, abiotic degradation occurs at a much slower rate than the biologic degradation reactions under natural conditions.

Under anaerobic conditions, CAHs with a high degree of chlorination, such as TCE and 1,1,1-TCA, can be biodegraded by reductive dehalogenation processes, such as hydrogenolysis and dihaloelimination, to produce less-chlorinated products (such as dichloroethylene, dichloroethane, and vinyl chloride). Further discussion on the physiochemical properties of CAHs is presented in the following section.

6.2.1.5 Physiochemical Properties of Volatile Organic Compounds

Table 6-2 lists physical properties for the various VOCs detected at the Site. A discussion of the physicochemical characteristics of the primary VOC constituents detected at the site is presented in the following paragraphs.

Aqueous Solubility

From the perspective of groundwater and surface water contamination, the most significant contaminant characteristic is solubility. VOCs tend to be among the more soluble organic compounds. In general, the more soluble organic compounds (those with the highest water solubility values) would have a tendency to dissolve in groundwater and migrate with the bulk motion of groundwater flow. In contrast, the least soluble organic compounds (those with the lowest water solubility values) would tend to sorb onto the aquifer material and be retarded/attenuated.

The water solubility of the predominant VOCs detected in groundwater at the site (xylenes; ethylbenzene; toluene, benzene; and 1,1-DCA; which are listed in ascending order of water solubility) range from 152 to approximately 5,500 mg/l (refer to Table 6-2). These values are considered mid-range to high water



solubility and suggest compounds that would tend to be mobile in groundwater. The most water soluble compounds detected were 1,4-dioxane and THF.

Advection

Advection is generally the dominant factor affecting the migration of dissolved organic compounds through a saturated porous media. Assuming that the organic compound's behavior is conservative (i.e., transport is not retarded by a physiochemical process such as sorption), advection is the process by which the dissolved compound is transported by the bulk motion of groundwater flow. Variations in the hydraulic conductivity and hydraulic gradients within the aquifer will result in different groundwater flow velocities. These variations in groundwater flow velocities result in different compound advection rates, which in turn, control the horizontal and vertical spreading of the dissolved compounds as they move within the aquifer system.

Given the nature of the contaminants and site conditions, advection is likely the most important transport process in determining the extent of the dissolved organic compounds in the groundwater system at the site.

Dispersion

Dissolved organic compounds can be spread by dispersion over a greater volume of the aquifer than what would be predicted solely from advection. This effect causes a decrease in the compound concentrations within the groundwater due to the mixing with "clean" groundwater (i.e., non-detectable levels of plume constituents), hence dispersion is a mechanism for dilution. Dispersion is also a key process in determining the fate of the dissolved VOCs at the site due primarily to regional groundwater flow patterns. As presented in Section 4, additional flow patterns from the western and eastern directions (off-site "clean" water) into the migrating contaminant plumes from the source area is occurring at the Site.

The process of dispersion is the result of mechanical mixing and molecular/chemical diffusion (e.g., dependent on a chemical's concentration gradient). Of these two processes, mechanical mixing is considered the dominant component of dispersion in sand/silt aquifers (Freeze and Cherry, 1979). Mechanical mixing is influenced by groundwater flow velocity within the aquifer materials (e.g., frictional forces, variations in pore geometry, etc.) and the aquifer dispersivity.

Sorption

Evaluating the sorption (adsorption or absorption) of organic chemicals to soil is essential for determining the fate of organic chemicals, their potential adverse impacts on the environment, and for the assessment of remedial response alternatives for conducting site remediation. If an organic chemical is extensively sorbed by soil particles, it will generally not migrate with groundwater. If the chemical is weakly sorbed to the soil, it may have a greater tendency to migrate with groundwater than sorb to soil.

The degree of sorption not only affects the chemical's mobility but other transport mechanisms and transformation reactions (i.e., rates of volatilization, photolysis, hydrolysis, biodegradation, etc.). The extent to which an organic chemical is sorbed is determined by the chemical's structure and the soil's physical and chemical characteristics. In determining the mobility of a chemical species in soil, a sorption coefficient is usually determined. For most organic compounds, the log octanol/water partition coefficient [$\log(K_{ow})$] and log soil/sediment partition coefficient [$\log(K_{oc})$] may be used as an indication of the mobility of a chemical species.

The $\log(K_{ow})$ values of the predominant VOCs detected in groundwater range from -0.27 (1,4-dioxane) to 3.28 (m-xylene). As indicated, the low $\log(K_{ow})$ values (generally less than 3) indicate that the predominant VOCs (with the exception of xylenes and ethylbenzene) will have a greater tendency to dissolve in water than to be sorbed to soils.



In addition to the (K_{ow}) and (K_{oc}) values, sorption to soil is also a function of the surface area of the soil particle, as well as the size, shape, and surface area of the sorbing molecule. For example, the finer the soils (i.e., greater percentage of silts and clays) the greater the surface area and thus the greater tendency for compounds to sorb to these soils. The higher concentrations of contaminants were detected in the intermediate overburden which is comprised of a higher percentage of these finer-grained materials than encountered at the water table.

In summary, the predominant VOCs detected in groundwater at the site have low $\log(K_{ow})$ and $\log(K_{oc})$ values and are expected to be highly to moderately soluble, mobile in water, and would have little tendency to sorb onto soil particles (except in areas of finer grained soils where the sorption rate may be controlled by surface area and grain size).

Volatilization

The extent to which an organic chemical can volatilize from the soil and water phases depends on its vapor pressure, aqueous solubility, and diffusion coefficient. For estimating releases from water to air, the Henry's Law constant, which is the partition coefficient that expresses the ratio of the chemical concentrations between air and water at equilibrium, is more appropriate than vapor pressure. Organic compounds with Henry's Law constants in the range of 10^{-3} atmospheres-cubic meter per mole ($\text{atm}\cdot\text{m}^3/\text{mole}$) and larger can be expected to volatilize readily from water; those values ranging between 10^{-3} to 10^{-5} $\text{atm}\cdot\text{m}^3/\text{mole}$ are associated with significant, but lesser volatilization, while compounds with values less than 10^{-5} $\text{atm}\cdot\text{m}^3/\text{mole}$ volatilize from water only to a limited extent (Lyman et al., 1990).

The Henry's Law Constant of the predominant VOCs detected in groundwater at the site range from 4.8×10^{-6} (1,4-dioxane) to 3.61×10^{-3} $\text{atm}\cdot\text{m}^3/\text{mole}$ (p-xylene). Based on their Henry's Law Constant values, several of the primary VOCs dissolved in groundwater have a Henry's Law Constant between 10^{-3} and 10^{-5} $\text{atm}\cdot\text{m}^3/\text{mole}$ and would be expected to volatilize to some extent from shallow groundwater. However, 1,4-dioxane and THF have constants of greater 10^{-5} and are expected to volatilize only to a limited extent.

Degradation

Degradation of volatile organic compounds is typically the result of biological and/or chemical degradation processes. The following discussion briefly outlines the potential types of degradational processes that may be occurring at the site.

The degradation of the purgeable aromatic compounds is primarily achieved through aerobic processes. Direct biological oxidation is an aerobic process that occurs when microorganisms are supplied with oxygen and nutrients necessary to utilize organic carbon as an energy source. The natural bacterial flora in soil has an ability to aerobically degrade aromatic hydrocarbons, thus having the potential to reduce the concentrations in soil and groundwater. Under normal environmental conditions, certain purgeable aromatics (such as benzene) are not expected to undergo hydrolysis, nor are they susceptible to oxidation or reduction reactions. However, under certain conditions, natural biodegradation of benzene, toluene, and other aromatic hydrocarbons has been reported (Borden, 1993). When sufficient oxygen is available in groundwater, as is the case near the water table, aerobic biodegradation of low-molecular-weight aromatic compounds is possible. The biodegradation rate depends on the availability of specific microorganisms, oxygen, electron acceptors, and nutrients. Other factors affecting the biodegradation rate include temperature and pH.

Anaerobic pathways of purgeable aromatic biodegradation are important because these compounds are frequently found under anoxic or reducing conditions (conditions which are observed at the site). Anaerobic biodegradation is primarily achieved through the mineralization of benzene, although this pathway is not well known or studied (Harwood et al., 1997).



For the chlorinated compounds (i.e., CAHs), the most common form of chemical degradation that may occur in the groundwater system is hydrolysis. This process involves the chemical reaction between a dissolved compound and water, the hydrogen ion, or the hydroxyl ion. In this reaction, one chlorine atom is removed from the dissolved constituent and replaced by a hydrogen atom. As part of this reaction, daughter/degradation products (i.e., other chlorinated compounds), chlorinated alcohols, and/or carboxylic acid may be formed.

In general, reductive dechlorination can be an important natural attenuation process for CAHs under anaerobic conditions. During reductive dechlorination, the CAH is used as an electron acceptor, not as a carbon source. For chlorinated ethenes, the process occurs sequentially from PCE to TCE to DCE to VC to ethene. Because the CAH is used as the electron acceptor, a carbon source to support microbial growth must be present.

1,4-dioxane and THF (dissolved in groundwater or surface water) are very resistant to degradation. In the atmosphere, both compounds degrade fairly quickly. In solution, a potential degradation pathway for each compound may be hydrolysis; however, limited data is available to support this condition. Given that each compound is classified as ethers, both compounds are generally resistant to hydrolysis. Refer to Section 6.3 for more discussion on degradation mechanisms.

6.2.2 Metals

As previously indicated, metals were one of the predominant contaminants detected throughout the site. The predominant metals detected in the soils across the site were chromium (detected in approximately 92 samples), vanadium (88 samples), nickel (85 samples), barium (84 samples), lead (84 samples), cobalt (80 samples), arsenic (78 samples) and zinc (74 samples). These metals were detected in greater than 85% of the samples analyzed for metals. The remaining inorganic constituents, primarily beryllium, mercury, selenium, cadmium and silver, were detected in less than 50% of the samples.

Similar to soils, the predominant metals detected in sediment primarily were arsenic, barium, aluminum, chromium, cobalt, zinc, vanadium, copper, and lead. The remaining metals were detected in less than 50% of the sediment. Surface water samples detected (in descending order of frequency) concentrations zinc, nickel, arsenic, cobalt, aluminum, vanadium, lead, copper, chromium and beryllium. Remaining metals were generally detected in less than 10% of the samples.

The most frequently detected inorganic constituents in groundwater were arsenic, nickel, aluminum, zinc, cobalt, vanadium, beryllium, chromium, cadmium, copper, lead, silver, cyanide, thallium, antimony and mercury (in descending order of frequency detected). For relative comparison purposes, metals concentrations were compared to maximum contaminant levels (MCLs) for the 1995 to 2005 groundwater data. This comparison indicated that concentrations of total arsenic were the most predominant metal detected in excess of the applicable MCL (a total of approximately 40 locations detected in excess of the MCL), followed by beryllium (22 locations), cadmium (21 locations), thallium (5 locations) and selenium (2 locations).

As discussed in Section 5.5, beryllium and cadmium were detected at levels above MCLs at several locations during previous groundwater sampling events with the most exceedances observed in the June/July 1999 data set. Review of all the beryllium and cadmium data indicated that all samples (with the exception of one location [MW-4S]) previously detected in excess of the MCL have been subsequently sampled at least once (and some over 3 additional rounds) and all results have exhibited levels below the MCLs (0.004 and 0.005 mg/l, respectively). Monitoring well MW-4S (located in the source area of the Southern Lobe) was most recently sampled in October 2006 and exhibited beryllium and cadmium concentrations of 0.005 and 0.0025 mg/l, respectively. All subsequent thallium and selenium concentrations have also been detected below its applicable MCL.



In summary, arsenic is the only inorganic constituent consistently detected in excess of MCLs and in greater than 65% of the groundwater data. Unlike the VOC plumes, arsenic concentrations in groundwater in excess of MCLs are also detected in upgradient wells suggesting that arsenic concentrations may be naturally occurring at “elevated” levels (e.g., concentrations that exceed the drinking water standards). Given these findings, arsenic is the only inorganic constituent characterized in this fate and transport evaluation. A brief description is provided below and a detailed evaluation of its prevalence at the site is presented in Section 6.3.

Arsenic is a highly soluble metalloid (exhibits both metallic and non-metallic characteristics). Its fate in the environment depends largely on the prevailing pH and Eh conditions. Arsenic forms the inorganic arsenate complex with oxygen, which is soluble under a variety of conditions. Arsenic sorbs to metal oxides and hydroxides, clays and organic matter, but this sorption is readily reversible. Sorption has a greater effect on arsenic fate in aerobic, acidic, fresh water. Under saline, reducing or anaerobic conditions, arsenic is more likely to be mobile.

Arsenic can be transformed into arsine gas under strongly reducing conditions, which could in turn migrate to an aerobic zone where it would become unstable and would release arsenic back into solution. Generally, waterborne and soil bound arsenic readily undergoes transformation, such as oxidation/reduction, microbial metabolism, volatilization, leaching, adsorption, and precipitation.

Arsenic is an element that occurs naturally in many oxidation states (commonly 0, +3, -3 and +5 for both inorganic and organic forms), which control its ultimate bioavailability. In soils, arsenic usually exists in an insoluble form as it tends to complex with organic material, iron, aluminum, and calcium, thereby accumulating in soils (ATSDR, 1989). Both inorganic and organic arsenic compounds can be present in surface waters, with arsenic (V) considered the predominant state.

In general, plants rarely bioaccumulate high concentrations of arsenic because it is phytotoxic. However, roots generally concentrate higher concentrations than leaves. In aquatic environments, arsenic is bioconcentrated primarily in algae and lower invertebrates, although biomagnification may occur (ATSDR, 1989).

6.2.3 Semi-Volatile Organic Compounds

Semi-volatile organic compounds (SVOCs) were detected in soil, groundwater, and sediment samples collected during the investigation. The predominant SVOCs detected in soil and sediment are generally classified as polynuclear aromatic hydrocarbons (PAHs). The predominant PAHs detected in soil were fluoranthene (detected in approximately 43% of the soil samples), followed by pyrene (41% of the soil samples), chrysene (38%), phenanthrene (38%), benzo(b)fluoranthene (36%), benzo(a)pyrene (35%), bis(2-ethylhexyl)phthalate (35%), benzo(a)anthracene (31%), benzo(k)fluoranthene (28%), indeno(1,2,3-cd)pyrene (28%), benzo(g,h,i)perylene (28%), naphthalene (22%) and anthracene (18%). The remaining SVOCs were detected in less than 15% of the soil samples. Review of the data indicates that these SVOCs are primarily limited to soils located in the Former Residence, Garage and Storage Area and certain portions of both landfill lobes.

Similar to soil the predominant SVOCs detected in sediment primarily consisted of PAHs, although detected at much lower frequency. The most detected constituent was bis(2-ethylhexyl)phthalate (detected in 9 of the 54 samples analyzed) followed by naphthalene (detected in 8 of 54 samples analyzed) and benzoic acid (detected in 5 samples). The remaining SVOCs were detected in less than 5% of the sediment samples (generally detected in 1 or 2 samples analyzed). Surface water samples detected concentrations of naphthalene (9 samples), bis(2-ethylhexyl)phthalate (4 samples), phenol (3 samples) and five other SVOCs with detections in 1 or 2 samples.

The predominant SVOCs detected in the groundwater across the site are generally classified as phenols and phthalates. Phenols (2,4-dimethylphenol, 2-methylphenol, 3-methylphenol/4-methylphenol, 4-



methylphenol, and phenol) and phthalates (diethyl phthalate and dimethyl phthalate) constitute approximately 80% of the SVOC detected in groundwater. In all, SVOC compounds were detected in approximately 40% of the samples analyzed for SVOCs (a total of approximately 158 samples [including temporary wells and stream piezometers]).

The discussion of SVOCs has been separated into the following two general classes: polynuclear aromatic hydrocarbons (PAHs) and phenols and phthalates.

6.2.3.1 Polynuclear Aromatic Hydrocarbons

Polynuclear aromatic hydrocarbons are a class of organic compounds with a low to moderate volatility and a low to moderate solubility. PAHs consist of hydrogen and carbon atoms in the form of two to seven fused benzene rings. The number and concentration of the rings, molecular weight, water solubility, and volatility strongly affect its biochemical interactions in the environment. Consequently, the fate and transport and toxicity of PAHs strongly correlate with the specific size of the PAH molecule.

In general, the PAHs detected at the site can be grouped into the following three categories based on their molecular weight:

- high molecular weight 5-ring aromatic PAHs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, and dibenz(a,h)anthracene - all highly hydrophobic and non-volatile;
- medium molecular weight 4-ring aromatic PAHs: fluoranthene and pyrene - hydrophobic and less volatile;
- low molecular weight 3-ring aromatic PAHs: phenanthrene (relatively water insoluble) and fluorene (volatile)

Water insoluble PAHs and highly hydrophobic compounds tend to partition to organic matter in soils and sediment. PAHs in soil and sediment may persist by adsorption to soil organic matter, giving rise to sorption, volatilization, and biochemical or chemical degradation.

Table 6-3 lists physical properties for the various SVOCs detected at the Site. As indicated on Table 6-3, the Henry's Law Constants for the PAHs are all above 10^{-5} atm-m³/mol with the higher molecular weight PAHs typically exhibiting a value of 10^{-7} atm-m³/mol. Compounds with values less than 10^{-5} atm-m³/mol volatilize only to a limited extent (Lyman, et al., 1990).

Sorption of PAHs to soils increases with increasing organic carbon content and is also directly dependent on particle size (ATSDR, 1994). As indicated on Table 6-3, the log K_{oc} for PAHs ranges from 3.8 to 6.54 (all but one PAH exhibits a log K_{oc} greater than 4). In general, compounds with log (K_{oc}) values greater than four tend to sorb strongly to soil organic carbon. Although PAHs were not widely detected in sediments, they would have a tendency for sorption given the levels of organic matter observed – sample results exhibited an average of 16% total organic carbon (maximum TOC level was observed at 85%).

As described in Section 6.2.1.5, the octanol-water partition coefficient (K_{ow}) is also used as a general indicator of a compounds tendency to sorb to soil. As shown on Table 6-3, the log K_{ow} for PAHs are greater than 3 (ranging from 4.18 to 6.40) which would indicate a greater tendency to be sorbed to soils than dissolved in water. This correlates well to the observed PAHs constituents detected in soil (up to 13 constituents detected) compared to the PAHs observed in groundwater and surface water (no PAHs detected).

Biodegradation is also considered a significant process for PAH degradation. PAHs generally are considered to undergo aerobic degradation. The rate of biodegradation in soils is affected by temperature, pH, oxygen, salinity, microbial population, and specific properties of the PAHs. Because most PAHs are



not significantly transformed or transported, they often remain concentrated near their source. As a result, microbes degrading the PAHs will often deplete the supply of oxygen and/or nutrients in that area. The result is that microbial degradation of the PAHs proceeds extremely slowly.

Transport of PAHs in groundwater will largely be controlled by advection and sorption. Soil surface areas also play a role in mobility of PAHs. The greater the surface area (which usually corresponds to decreasing particle size) generally correlates to lower mobility. PAHs are generally not susceptible to chemical hydrolysis.

6.2.3.2 Phenols and Phthalates

As presented in Section 5.5, phenols and phthalates were the predominant SVOCs detected in the groundwater across the site. Specifically, concentrations of 2,4-dimethylphenol, 2-methylphenol, 3-methylphenol/4-methylphenol, 4-methylphenol, phenol, diethyl phthalate and dimethyl phthalate were detected.

Phenols present in the subsurface tend to be fairly mobile, with little sorption to soil or bioaccumulation; the actual transport rate and degradation in groundwater will vary with pH. Biodegradation of phenols will ultimately result in the production of carbon dioxide and methane. In contrast, phthalates tend to sorb to soil, with limited leaching into groundwater. Once in groundwater, however they can be degraded microbially.

6.3 SITE-SPECIFIC CONTAMINANT MIGRATION

As discussed in Section 5.1 and 5.2, the landfill lobes and the former drum disposal area are the primary source areas for contaminants detected at the site. This is evident based on the concentrations of VOCs, and SVOCs detected in groundwater (highest concentrations adjacent the source areas), the direction of groundwater flow, and the decreasing contaminant concentrations downgradient of the source areas.

Understanding the processes involved in the fate and transport of the specific contaminants (discussed in Section 6.2 above) is a significant consideration when determining their migration characteristics/patterns away from the source areas. As with the discussion of the hydrogeologic characteristics of the site (Section 4), the discussion on the migration pathways of the contaminant plumes is provided in the following section.

6.3.1 Plume Characterization and Migration Pathways - VOCs

A depiction of the approximate areal extent of the primary constituents detected in groundwater was presented in Figures 5-5a through 5-5d. These figures depict the Southern Lobe and the Former Drum Disposal Area as the primary source areas for these contaminant plumes. The purgeable aromatic hydrocarbons and tetrahydrofuran plumes are similar in configuration; whereas the 1,4-dioxane plume is more widespread, detected at lesser concentrations, and suggests source contribution from both landfill lobes. This may be attributable to 1,4-dioxane being more soluble and less degradable than the aromatic hydrocarbons.

The predominant factors that will ultimately control the migration pathways of the contaminant plumes are the hydrogeologic environment, the location and characteristics of the source areas, and the partitioning/migration characteristics of the specific contaminants comprising the plume. Based on the previous discussion on source characterization, fate and transport characteristics of the predominant contaminants, and the site-specific hydrogeologic environment, advection, dispersion, and natural degradation/attenuation most likely are the primary characteristics controlling the migration of the dissolved VOC plumes away from the source areas in groundwater. Figures 5-5a through 5-5d also show that the plumes are generally contained within the immediate boundaries of the site (i.e., plume configurations are controlled by groundwater flow, discharge to the brook and associated wetlands, and degradation/attenuation mechanisms).



As groundwater flows through the source areas, VOCs partition into the groundwater and migrate with groundwater flow away from the source areas forming a dissolved VOC plume. The predominant mechanism for migration of the plume away from the source area is through advection. In the area of the Southern Lobe, it appears that groundwater (based on potentiometric head data) and the dissolved VOCs (based on concentrations detected in monitoring wells) initially migrates away from the source area in a predominantly northeasterly to northerly direction. In the area of the Former Drum Disposal Area, the dissolved VOCs initially migrate in a southwesterly to westerly direction towards Sutton Brook and the associated wetlands.

Once both plumes reach the general vicinity of the brook/wetlands, the plumes merge with regional groundwater flow and travel in a predominantly northerly flow direction. Based on hydraulic gradients, the dissolved VOC plume predominantly migrates in the horizontal direction with a slight upward component of flow as the plume approaches the brook/wetlands.

To aid in estimating the rate of contaminant movement, the numerical groundwater model was used to simulate hydrogeologic conditions and the movement of groundwater in the vicinity of the site. Given that advection is the primary transport mechanism for the dissolved VOC plume, the model was a useful tool to aid in the understanding of potential contaminant migration pathways. The results of the model-simulated groundwater flow directions were generally consistent with groundwater flow directions configured from the groundwater level measurements. Based on the particle tracking analysis performed as part of the model calibration, the simulated discharge locations for particles placed in the source areas were consistent with mapped contaminant locations.

The higher VOC concentrations are detected in the intermediate overburden. Hydraulic gradients in this zone of the aquifer are relatively flat (0.001 ft/ft range) and when combined with low conductivity, result in a reduced groundwater velocity and subsequent reduced contamination migration rates. As such, contaminant dissolution, flushing and dispersion processes are expected to be a slower process.

The groundwater data also indicates that contamination is limited to the overburden and has not migrated into the bedrock aquifer. The bedrock wells installed downgradient of the source areas (MW-7R, MW-8R, MW-22R, and MW-17B) were either non-detect for VOCs or detected low concentrations (less than 2 ug/l). As shown on Figure 4-4, several of these wells are located within the bedrock low or “trough” downgradient of the source areas. Based on the location of these wells and the low concentrations of VOCs it is not likely that a non-aqueous phase would be present in bedrock in this low area.

In summary, both the potentiometric surveys and the groundwater model confirm that dissolved VOCs and SVOCs (including purgeable aromatics, chlorinated compounds, and ketones, among others) migrate away from the two main source areas and toward Sutton Brook and the wetland areas surrounding Sutton Brook. Once at the brook and in the area of the wetlands surrounding the brook (downgradient from both source areas), regional groundwater controls the flow regime with groundwater following the brook, in a predominantly northerly flow direction.

Though the dissolved VOC plume predominantly migrates in the horizontal direction, hydraulic data collected at the site shows that there is also a slight upward component of flow as the plume approaches the brook/wetlands. Along with the low hydraulic conductivity and reduced groundwater velocity estimated in the intermediate overburden, the upward component of flow may also have an impact on contaminant transport at the site since the potential for off-site groundwater transport is further reduced.

Contaminant Trend Evaluation

No significant increasing trends in concentrations of dissolved VOCs or significant changes in the shape of the dissolved VOC plumes have been detected at the site throughout the sampling events. Although a significant amount of new groundwater data has been recently collected, the extent and concentration



distribution of the plume on the site appears to be generally consistent throughout the past ten years of sampling (dating back to 1995). Additionally, decreasing contaminants trends in VOCs are apparent especially for the VOC contaminant mass across the site.

The following table summarizes the total VOC levels in select wells over time.

	Jun-95	Jun-99	Jul-99	Sep-99	Mar-01	
MW-4S	4,979	NA	5,447	29,447	67,389	
MW-9	NA	98,783	117,087	1,493,600	NA	
MW-11	NA	NA	5,090	NA	NA	
MW-17D	NA	NA	NA	NA	67	
	Nov-04	Sep-05	Dec-05	Feb-06	Jun-06	Oct-06
MW-4S	32,425	47,612	45,510	36,550	38,500	28,930
MW-9	358,600	407,700	419,400	442,890	352,200	269,950
MW-11	1,134	1,048	834	873	976	814
MW-17D	122	22	108	85	103	54
NOTE: Ketones and acetone were not analyzed in 1995 and 1999, thereby skewing the total results. Concentrations reported in ug/l.						

Since 2001, source area wells (MW-4S and MW-9) demonstrated a stable to slightly decreasing trend in total VOC concentrations. Total VOCs in intermediate well MW-11 have consistently shown decreasing levels since its initial sampling in 1999. Groundwater in downgradient well MW-17D has exhibited relatively stable total VOC levels.

To further evaluate contaminant trends associated with the predominant categories of VOCs detected within the overall VOC plumes, those compounds detected at the highest frequency and concentrations were evaluated based on available data collected from 1999-2001, 2004-2005, and 2006. Concentrations of purgeable aromatics, chlorinated VOCs (CVOCs), ketones, 1,4-dioxane, and tetrahydrofuran were compared against the relative distance from the source area (i.e., at the source, intermediate to and downgradient from the source) and against time (over the monitoring periods 1999-2001, 2004-2005, and 2006). The analysis also includes a comparison of select SVOCs from the same monitoring wells and monitoring periods. This evaluation of the data was completed for the FDDA and the Southern lobe and presented as Figures 6-1a and 6-1b, respectively.

Features that can be seen in this trend analysis include:

- The highest concentrations of VOCs are detected in the source areas, with ketones comprising the majority of the total VOC contaminant mass;
- Each contaminant plume area (source, intermediate and downgradient) reveals an overall decrease over time. No increasing trends in concentrations of dissolved VOCs (or SVOCs) were observed over the approximate 10-year period for either area; however, concentrations of tetrahydrofuran and CVOCs within the Southern lobe source area wells (MW-4S and MW-5) have shown some fluctuation over time.
- Each contaminant plume demonstrates overall lower concentrations of VOCs as the plume migrates further from the source areas; however the distribution of contaminant and concentration



changes with distance from the source areas. The further downgradient locations detected higher concentrations of more soluble, mobile and harder to degrade contaminants (1,4 dioxane and/or chlorinated VOCs), whereas ketones and purgeable aromatics, which were the predominant VOCs detected near the source areas are reduced to non-detect levels in the downgradient wells.

- In the FDDA, at each separate monitoring period (1999-2001, 2004-2005, and 2006) there is a significant reduction of purgeable aromatic hydrocarbons and ketones observed as the plume migrates into the intermediate area and finally to non-detect levels in downgradient areas.

Natural Attenuation Processes

As discussed previously, analytical and geochemical data have indicated that natural attenuation processes have and continue to effectively degrade and reduce the mass of site contaminants. These natural in-situ attenuation processes include biodegradation, dispersion, dilution, adsorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants.

Biodegradation (also, chemical/biological stabilization, transformation, or destruction) of organic compounds is often one of the more important fate processes resulting in their removal from a subsurface environment. Microbes gain energy by promoting chemical oxidation, hydrolysis, or substitution reactions in the organic compound. The resulting product is generally more water soluble and often more readily degraded than the parent compound.

The primary environment for biological degradation is in groundwater, because it provides a transport media for the microbes and the chemicals, which act as their energy source, to come into contact. Microbial activity can be aerobic (requiring oxygen) or anaerobic (occurring in the absence of oxygen). Aerobic degradation in the subsurface is often limited by the availability of oxygen to the microbes. Thus, compounds which otherwise might readily biodegrade can persist in the environment due to limits on oxygen transfer. However, in the absence of an oxygen-rich environment, other naturally occurring chemicals can be substituted as electron acceptors during biodegradation. Further discussion on the potential biodegradation processes occurring on-site and their reaction footprints are provided below.

Electron Acceptors - Oxygen, Nitrate and Sulfate

A review of the electron acceptors found in groundwater at the site, both within and downgradient of the FDDA and Southern lobe, was performed to assess the geochemical environment present in the area (and therefore the potential for biological degradation). The presence or absence of electron acceptors (oxygen, nitrate and sulfate) provides a potential footprint of microbial degradation. The disappearance of these acceptors in conjunction with a decrease in contaminants may indicate that each has been consumed through degradation processes.

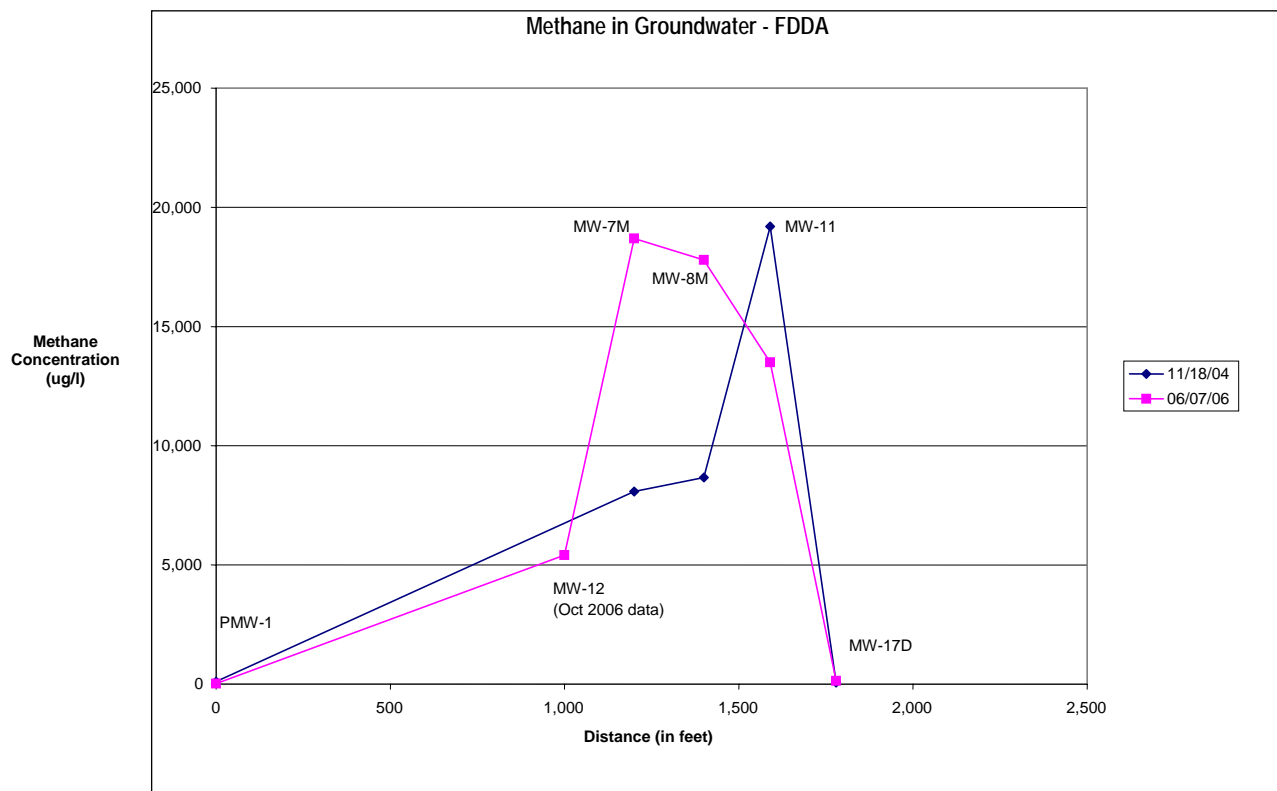
Consistently, reduced levels of dissolved oxygen (less than 1 mg/l) have been measured within and immediately downgradient of the two source areas. These measurements indicate that anaerobic conditions have prevailed in these areas and that aerobic degradation is likely not the primary driver for mass reduction on-site. In addition to the reduced oxygen levels in groundwater, ORP levels are predominantly negative in the source areas and immediately downgradient from the source areas (in the intermediate zone) demonstrating that reductive conditions exist in these areas.

Nitrate and sulfate levels were measured in select wells on-site in June 2006 to evaluate the potential for denitrification or sulfate reducing processes occurring on-site. The spatial analysis of the results across the site shows both nitrate and sulfate concentrations to be greater at upgradient and downgradient locations, as compared to those locations within the source areas or immediately downgradient of the source areas. The low levels of nitrate and sulfate in source area groundwater may demonstrate that denitrification or sulfate reduction processes are contributing to mass reduction on-site.



Metabolic Byproducts – Methane and Ferrous Iron

Two additional potential biodegradation processes include methanogenesis and iron reduction. Methanogenesis consists of the fermentation of contaminants into methane gas and carbon dioxide, providing methane as a footprint for this type of reaction. As methane gas is a common byproduct of landfill waste (and demonstrated to be present on-site as a result of the two landfill lobes) and due to the location of the dissolved VOC contaminant plume (immediately downgradient of the landfills), the specific source(s) of methane on site is difficult to isolate. The figure below presents the methane levels detected in groundwater upgradient, within and downgradient of the Northern lobe and FDDA on two separate monitoring events (in 2004 and 2006), illustrating the change in methane levels over distance from the northern edge of the Northern lobe (PMW-1) to downgradient monitoring well MW-17D.



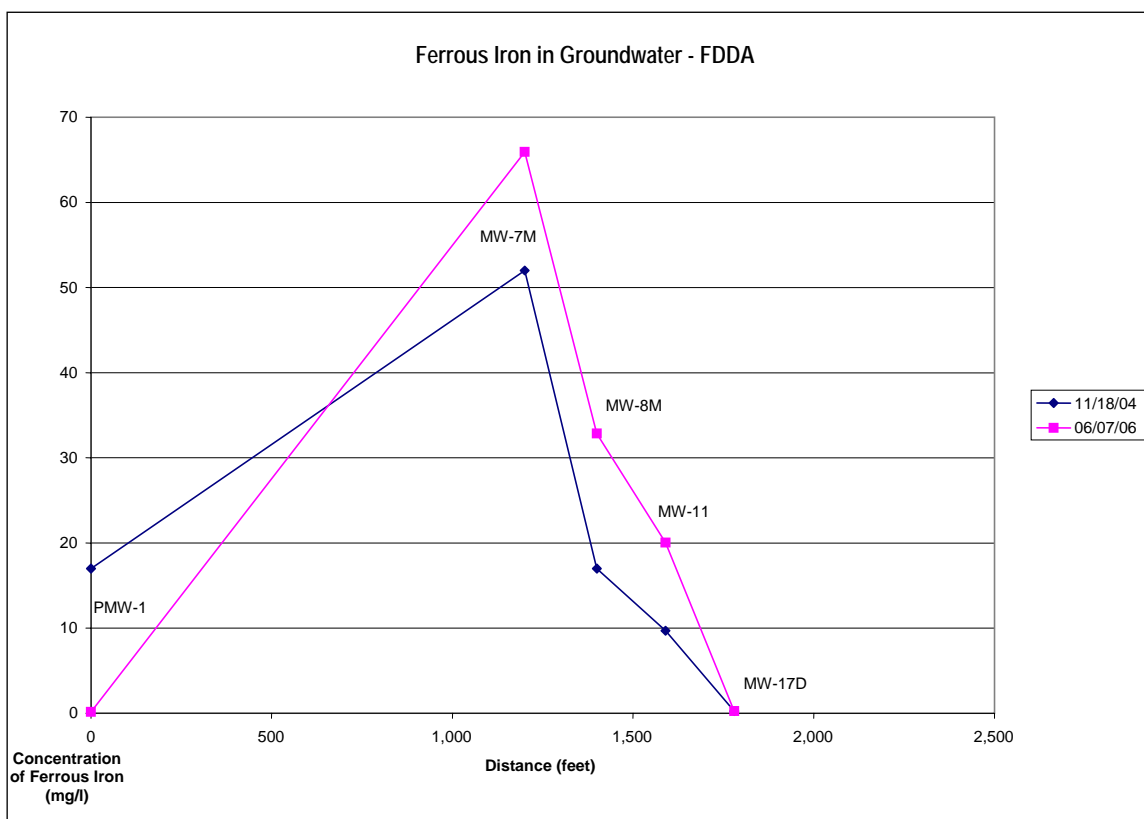
The figure demonstrates that monitoring points hydraulically upgradient of the Northern landfill lobe (PMW-1) and further downgradient of the landfill and the FDDA at the perimeter of the site (MW-17D) show very little dissolved methane in groundwater. In both 2004 and 2006, in the area between MW-7M, MW-8M, and MW-11, an increase in dissolved methane concentrations is shown.

To evaluate the contribution of methane from the Northern lobe, the dissolved methane concentration in MW-12 is plotted on the figure above. MW-12 is adjacent to the Northern lobe, immediately upgradient of the FDDA. As indicated by the 2006 data, the methane concentration detected at MW-12 is less than that detected at MW-7M, MW-8M, and MW-11. This suggests that there is contribution of methane from the decomposition of the buried waste at the Northern lobe to groundwater within and downgradient of the FDDA. However, as groundwater travels further away from the Northern lobe, within the FDDA, an increase in methane concentration is measured, providing the potential that additional breakdown (of contaminants in groundwater) via methanogenesis is occurring. It should also be noted that the highest levels of dissolved methane in groundwater have been detected within deeper regions (25 to 45 feet bgs). Therefore, the presence of methane in groundwater is believed to be a result of a combination of mechanisms, dissolution of landfill gas and a by-product of methanogenesis.

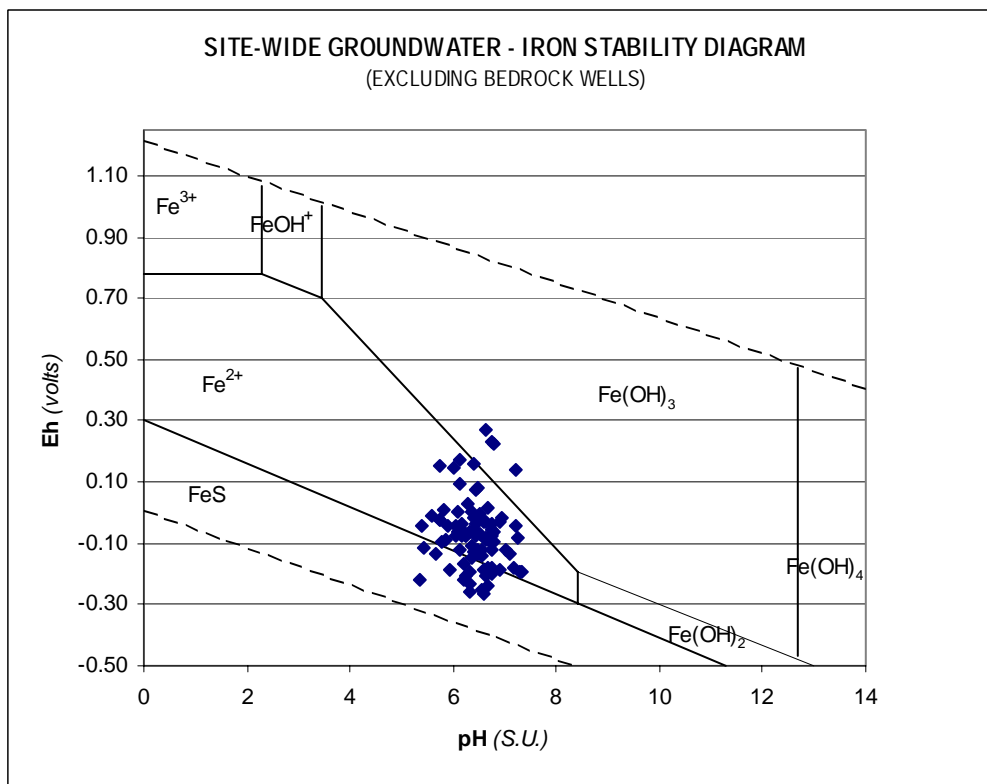


A similar evaluation was performed to examine the potential for iron reduction in the area of the FDDA. During iron reduction processes, the reduction of ferric iron (Fe^{3+} - electron acceptor) produces dissolved ferrous iron (Fe^{2+} - metabolic byproduct). Therefore, ferrous iron can be utilized as a footprint for this type of reaction. The figure below presents the ferrous iron levels detected in groundwater upgradient, within and downgradient of the Northern lobe and FDDA on two separate monitoring events (in 2004 and 2006), illustrating the change over distance from the northern edge of the Northern lobe (PMW-1) to downgradient monitoring well MW-17D.

The figure illustrates that there is an increase in the concentration of dissolved ferrous iron in groundwater in the area of MW-7M, MW-8M, and MW-11 (within and immediately downgradient of the FDDA). In addition, a slight increase in ferrous iron has been observed from 2004 to 2006 in each of those monitoring wells. This elevated presence of ferrous iron indicates that iron reduction degradation processes may be occurring within and downgradient of the FDDA.



In regards to other areas of the site, the percentage of ferric iron detected in site-wide groundwater (versus ferrous iron) was greater in groundwater from bedrock wells and those wells located downgradient of the source areas. In contrast, the highest percentage and the highest levels of ferrous iron were detected in the source areas (FDDA and adjacent to the Southern lobe). The elevated presence of ferrous iron demonstrates that iron reduction processes may be occurring in these regions with the interaction of site contaminants with ferric iron and the subsequent generation of ferrous iron. This is further illustrated through the following iron stability diagram. Site-wide groundwater chemistry (redox potential and pH) results (through 2004, excluding bedrock wells) are plotted below. Measured redox potential (Eh) and pH across the site demonstrate ferric iron reduction to dissolved ferrous iron (Fe^{2+}) for the majority of site groundwater.



◆ Site Groundwater

In summary, the VOC groundwater data presented in the preceding paragraphs demonstrates that natural attenuation processes are occurring within and downgradient of the source areas. These natural attenuation processes, including biodegradation, dispersion, dilution, sorption, volatilization and chemical or biological stabilization, transformation, or destruction, have and continue to effectively stabilize and/or decrease the size of the contaminant plume. In addition, chemical footprint indicators, including the absence of electron acceptors oxygen, nitrate and sulfate and the presence (and subsequent increase spatially on-site) of metabolic byproducts methane and ferrous iron have been measured within and immediately downgradient of source areas on-site, indicating that biodegradation processes are interacting with contaminants in groundwater.

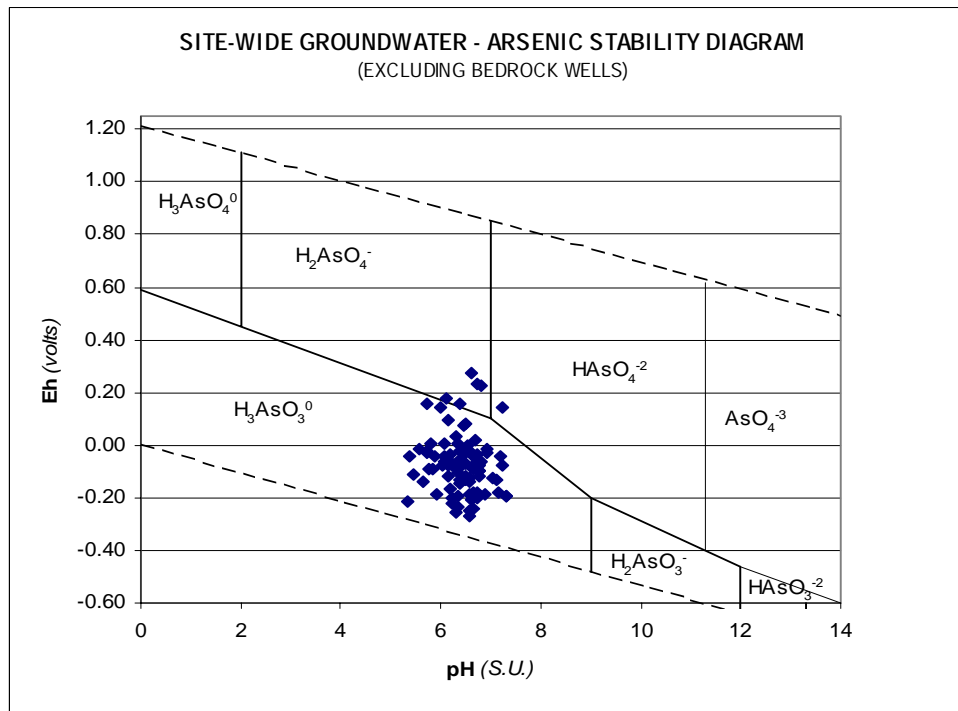
6.3.2 Plume Characterization and Migration Pathways - Arsenic

Unlike the dissolved VOC and SVOC plumes, arsenic concentrations in groundwater in excess of MCLs are detected in site wells as well as upgradient wells, suggesting that arsenic concentrations may be naturally occurring at “elevated” levels. The highest concentrations of arsenic in groundwater have been detected adjacent to and immediately downgradient of the source areas (FDDA and the Southern lobe). The elevated levels adjacent to and immediately downgradient of source areas is believed to be a result of the reductive release of arsenic in select areas on-site. Although some mass of arsenic may be a result of deposition into the source areas, the resulting geochemistry within the subsurface has likely played a significant role in the elevated arsenic levels immediately downgradient of the source areas.

The following arsenic stability diagram illustrates that reducing conditions are present on-site with the majority of groundwater within the anaerobic arsenite (H_3AsO_3) range. Research by others has shown that arsenic concentrations can increase as a result of microbial iron reduction under reducing conditions. The availability of organic carbon from the source areas, in conjunction with the reducing conditions



present on-site, result in an environment susceptible to arsenic release into site groundwater via microbial iron reduction. Measured redox potential (Eh) and pH across the site (illustrated in the iron stability diagram presented above) demonstrate that ferric iron reduction may be occurring across the site; therefore the increased levels and slight upward trend of arsenic in these same areas within the site may be attributable to the natural microbial processes occurring in-situ.

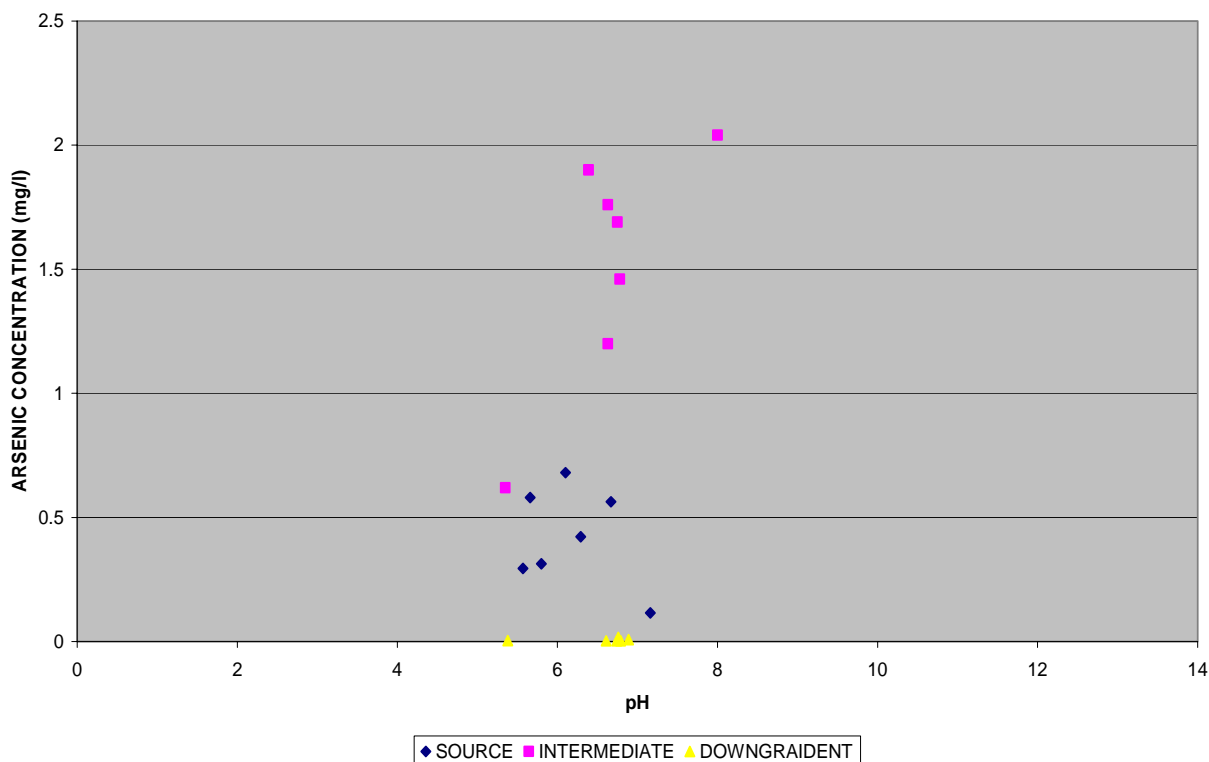


◆ Site Groundwater

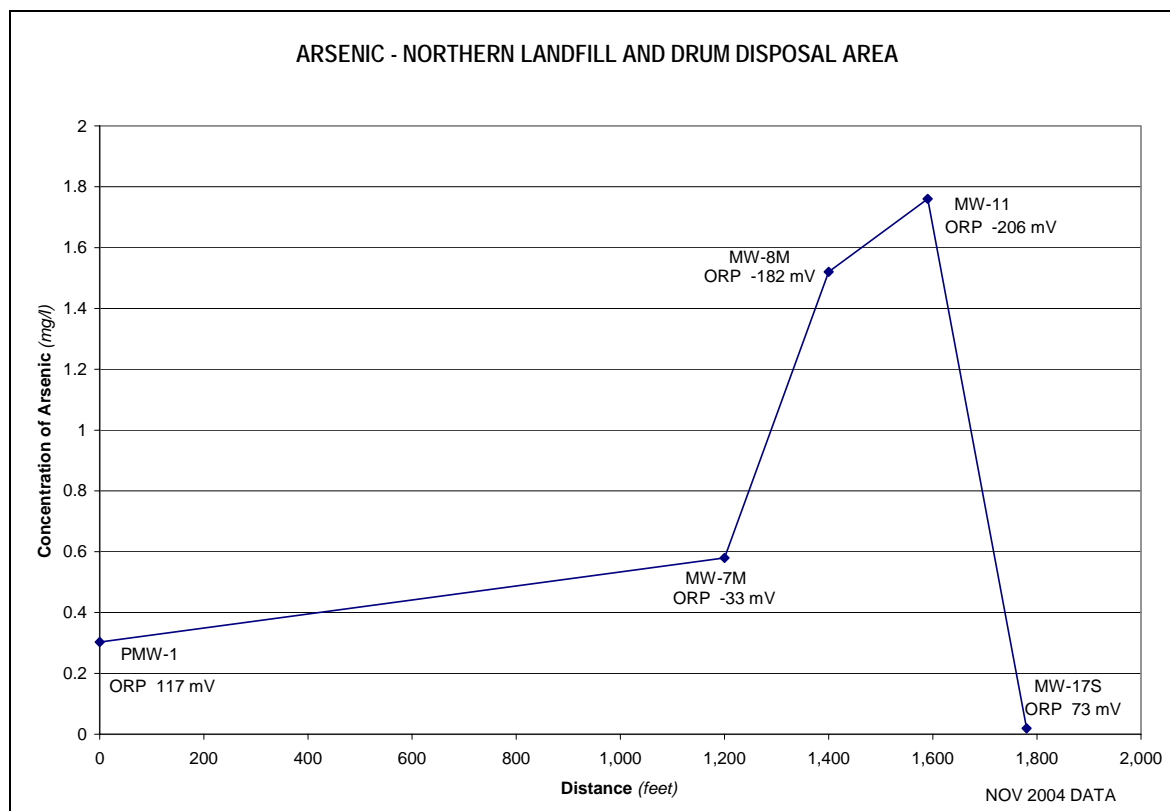
Although groundwater upgradient of the landfill contains arsenic levels above the MCL, these concentrations are generally lower than within and immediately downgradient of the FDDA and Southern lobe. Arsenic levels in the FDDA were compared to pH levels based on their location (source, intermediate, and downgradient), as shown on the plot below. pH levels were consistent; however, arsenic levels in the downgradient wells were lower than in the source and intermediate wells.



DRUM DISPOSAL AREA pH vs Arsenic



The highest arsenic concentrations in the area are located in the intermediate zone (immediately downgradient of source area). This illustrates that naturally occurring arsenic may be present at levels below 0.7 mg/l; as groundwater flows to the intermediate located wells, the arsenic concentrations increase to greater than 1 mg/l. This suggests that in-situ geochemical processes on-site are attributing to the release of naturally occurring arsenic in this area. This is further illustrated by the second plot below which evaluates arsenic concentration in relation to ORP along a groundwater flow path. As reducing conditions prevail (ORP is reduced) with the flow of groundwater through the Northern lobe and FDDA, the concentration of arsenic increases; as the ORP rises again and oxidizing conditions result towards the brook, arsenic concentrations reduce as it binds, adsorbs, and/or reacts to fall out of solution.



Even with the increase in arsenic concentrations immediately downgradient of the source areas (intermediate zone), with the increase in ORP further downgradient within the wetlands; the arsenic concentrations again decrease before migrating from the Site. Concentrations of arsenic in groundwater along the downgradient edge of the site are either low (below the MCL) and/or stable, further demonstrating the stability of the groundwater plume on-site.

Table 6-1

**Fate and Transport Processes and Properties of Subsurface Materials, Contaminants, and Site Conditions
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site – Tewksbury, Massachusetts**

Fate or Transport Pathway/Processes	Property of Subsurface Materials (soil, groundwater, etc.) and/or Site Condition	Property of Contaminant
Leaching from soils and waste to groundwater	Organic content, clay content, specific surface area, infiltration rates, leachability (contaminant concentrations in groundwater and surface water)	Solubility, octanol-water partition coefficient, organic carbon partition coefficient, leachability (contaminant concentrations in groundwater and surface water)
Volatilization to ambient or indoor air	Degree of saturation; soil vapor flow; ground surface covering	Vapor pressure, Henry's law constant, molecular diffusion
Migration with Groundwater Flow		
Advection	Groundwater gradient, groundwater velocity, hydraulic conductivity, porosity	Independent of contaminant
Dispersion	Dispersivity, pore water velocity	Diffusion/Dispersion coefficients
Preferential Flow	Fractures, geologic material variability	Specific Gravity
Discharge from Groundwater to Surface Water and Migration with Surface Water	Groundwater/surface water interactions; rate of groundwater flows and discharge velocities	Independent of contaminant
Non-Biological Processes		
Sorption	Organic content, clay content, specific surface area	Solubility, octanol-water partition coefficient, organic carbon partition coefficient
Ion exchange	Cation exchange capacity, ionic strength	Valency
Hydrolysis	pH	Hydrolysis half-life
Photolysis	Ground surface covering (exposure to sunlight)	Compound structure (bonds)
Speciation - Dissolution, Weathering, and Precipitation	pH	Solubility versus pH, speciation reactions
Oxidation/Reduction Reactions	Redox reactions	Redox potential

Table 6-1

**Fate and Transport Processes and Properties of Subsurface Materials, Contaminants, and Site Conditions
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site – Tewksbury, Massachusetts**

Fate or Transport Pathway/Processes	Property of Subsurface Materials (soil, groundwater, etc.) and/or Site Condition	Property of Contaminant
Biological Degradation	Microorganisms, nutrients, pH, oxygen, temperature	BOD, COD, degree of halogenation
Wind blown/Stormwater runoff	Ground surface covering; particulate matter	Sorption to particulate matter
Plant uptake	Presence of plants, shrubs, etc.	Bioaccumulation rates
Bioaccumulation by organisms	Presence of organisms, organic carbon content of soil/sediment	Bioaccumulation rates, octanol-water-partitioning coefficient, contaminant concentration
Note: Data obtained from "Subsurface Transport and Fate Processes", Knox, et. al., 1993; and "The Soil Chemistry of Hazardous Materials", Dragun 1998.		

Table 6-2

Physicochemical Properties – Volatile Organic Compounds
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site – Tewksbury, Massachusetts

Constituent	Formula Weight	Physical State	Boiling Point (°C)	Density at 20°C (g/cm ³)	Diffusivity in Water (10 ⁻⁵ cm ² /sec)	Henry's law constant (atm-m ³)/mole	log K _{oc}	log K _{ow}	Solubility in water (mg/l)	Vapor pressure (mmHg)
Purgeable Aromatic Hydrocarbons										
Benzene	78.11	Clear, colorless to light yellow watery liquid with an aromatic or gasoline-like odor. Odor threshold in air is 0.84 ppm.	80.1	0.8765	0.98	5.55x10 ⁻³	1.79	2.186	1,800	60 (15°C)
Ethylbenzene	106.2	Colorless liquid with an aromatic odor.	136.2	0.867	0.78	7.88x10 ⁻³	2.34	3.15	169	9.6 (25°C)
Isopropyl benzene	120.19	Colorless liquid with a sharp, penetrating, aromatic odor.	151	0.862	0.71	0.0115	3.45	3.66	61.3	4.5 (25°C)
1,2,4-Trimethylbenzene	120.19	Liquid.	169	0.876	0.792	6.16x10 ⁻³	3.34	3.63	57	2.1 (25°C)
1,3,5-Trimethylbenzene		Liquid.	165	0.865	0.867	8.77x10 ⁻³	2.82	3.42	48	2.48 (25°C)
n-Propylbenzene	120.19	Liquid.	159	0.862	NA	0.0105	2.86	3.69	52.2	3.42 (25°C)
Toluene	92.14	Colorless, water-white liquid with a pleasant odor similar to benzene. Odor threshold in air is 170 ppb.	110.6	0.8669	0.86	6.64x10 ⁻³	2.14	2.63	519	22 (20°C)
m-Xylene	106.17	Clear, colorless, water liquid with a sweet, aromatic odor. Odor threshold in air is 1.1 ppm.	139.1	0.8642	0.78	4.96x10 ⁻³	3.2	3.28	192	8.3 (25°C)
o-Xylene	106.17	Clear, colorless liquid with an aromatic odor.	144.4	0.8802	0.79	3.61x10 ⁻³	2.03	3.16	152	6.6 (25°C)
p-Xylene	106.17	Clear, colorless, watery liquid with a sweet odor.	138.3	0.8811	0.79	4.83x10 ⁻³	2.72	3.15	195	8.8 (25°C)
1,4-Dioxane and Tetrahydrofuran										
1,4-Dioxane	88.11	Colorless liquid with an mild ether-like odor detectable at 0.8 to 172 ppm. Hygroscopic.	101.5	1.0337	1.02	4.8x10 ⁻⁶	0.89	-0.27	1x10 ⁶	202.5
Tetrahydrofuran	72.11	Colorless liquid with an ether-like odor detectable at 2 to 50 ppm. Hygroscopic.	66	0.886	NA	7.05x10 ⁻⁵	0.44	0.46	1x10 ⁶	162.2 (25°C)
Ketones										
4-Methyl-2-Pentanone	100.16	Colorless liquid with a pleasant odor.	117.4	0.7978	7.8x10 ⁻⁶	1.38x10 ⁻⁴	1.04	1.31	1.9x10 ⁴	19.9 (25°C)
2-Butanone	72.11	Clear colorless liquid with a fragrant mint-like, moderately sharp odor detectable at 2 to 85 ppm.	79.6	0.805	9.8x10 ⁻⁶	5.69x10 ⁻⁵	0.58	0.29	2.23x10 ⁵	90.6 (25°C)
Chlorinated Aliphatic Hydrocarbons										
1,1-Dichloroethane	98.96	Clear, colorless, oily liquid with a chloroform-like odor.	57.3	1.1757	1.05	5.6x10 ⁻³	1.72	1.78	5,050	227 (25°C)
1,2-Dichloroethane	98.96	Clear, colorless, oily liquid with a pleasant, chloroform-like odor. Odor thresholds in air ranges from 6 to 40 ppm.	83.5	1.2351	0.99	9.8x10 ⁻⁴	1.58	1.48	8,300	78.7 (20°C)
cis-1,2-Dichloroethene	96.94	Clear, colorless liquid.	60.1	1.284	1.13	4.08x10 ⁻³	1.69	1.86	6,410	200 (25°C)
1,1-Dichloroethene	96.94	Colorless liquid or gas with a mild, sweet, chloroform-like odor. Odor threshold in air is 190 ppm.	31.56	1.218	1.04	2.6x10 ⁻²	1.81	1.48	2,250	495 (20°C)
trans-1,2-Dichloroethene	96.94	Colorless, viscous liquid with a sweet, pleasant odor. Odor threshold in air is 17 ppm.	47.5	1.2565	1.13	9.39x10 ⁻³	1.58	2.06	6,300	265 (20°C)
Ethyl ether	74.12	Colorless liquid with a characteristic, sweet, ether odor detectable at 0.33 ppm. Hygroscopic, air-light sensitive.	34.5	0.7134	0.93	1.23x10 ⁻³	1.83	0.89	6.04x10 ⁴	538 (25°C)
Methylene chloride	84.93	Clear, colorless liquid with a sweet, penetrating ethereal odor. Odor threshold in air ranges from 205 to 307 ppm.	40.1	1.3266	1.17	2.19x10 ⁻³	1.00	1.3	13,200	362 (20°C)
1,1,1-Trichloroethane	133.4	Colorless, watery liquid with an odor similar to chloroform. Odor threshold in air is 100 ppm.	74.1	1.339	0.88	1.72x10 ⁻²	2.13	2.49	300	96 (20°C)
Trichloroethene	131.39	Clear, colorless, watery-liquid with a chloroform-like odor. Odor threshold in air is 21.4 ppm.	87.2	1.461	0.91	1.08x10 ⁻²	1.97	2.6	1,100	56.8 (20°C)
Vinyl chloride	62.5	Colorless, liquified compressed gas with a faint, sweetish odor.	-13.4	0.9106	0.123	0.027	1.27	0.6	2,760	2,320 (20°C)
<p>Notes:</p> <p>Data obtained from one of the following sources: "Groundwater Chemicals Desk Reference" (Montgomery, 1996), USEPA Soil Screening Guidance (July 1996)., Pennsylvania DEP (2001), <www.chemfinder.com></p> <p>NA = Not available.</p> <p>°C = degrees Celsius</p> <p>g/cm³ = grams per cubic centimeter</p> <p>cm²/sec = square centimeters per second</p> <p>(atm-m³)/mole = atmosphere-cubic meter per mole</p> <p>log K_{oc} = Soil sorption coefficient</p> <p>log K_{ow} = Octanol/water partition coefficient</p> <p>mg/l = milligrams per liter</p> <p>mmHg = millimeters of mercury</p>										

Table 6-3

Physicochemical Properties – Semi-Volatile Organic Compounds
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site – Tewksbury, Massachusetts

Constituent	Formula Weight	Physical State	Boiling Point (°C)	Density (g/cm ³)	Diffusivity in Water (10 ⁻⁵ cm ² /sec)	Henry's law constant (atm-m ³)/mole	log K _{oc}	log K _{ow}	Solubility in water (mg/l)	Vapor pressure (mmHg)
Polynuclear Aromatic Hydrocarbons (PAHs)										
Benzo(a)anthracene	228.3	Colorless leaflets or plates with a greenish-yellow fluorescence.	437.6	1.274 (20°C)	0.9	3.35x10 ⁻⁶	5.55	5.91	1x10 ⁻²	5.0 x 10 ⁻⁹ (20°C)
Benzo(b)fluoranthene	252.32	Solid	357	NA	0.55	1.1x10 ⁻⁴	6.08	6.4	1.4x10 ⁻³	5.0 x10 ⁻⁷ (20°C)
Benzo(k)fluoranthene	252.32	Pale yellow needles	480	NA	0.55	8.29x10 ⁻⁷	6.08	6.4	5.5x10 ⁻⁴	9.59 x10 ⁻¹¹ (25°C)
Benzo(ghi)perylene	276.34	NA	500	NA	NA	3.31x10 ⁻⁷	6.43	6.63	2.6x10 ⁻⁴	1.0 x10 ⁻¹⁰ (25°C)
Benzo(a)pyrene	252.32	Odorless, yellow, orthorhombic or monoclinic crystals. Solution in	495	1.351 (20°C)	0.9	1.13x10 ⁻⁶	5.98	6	4x10 ⁻⁴	5.49 x 10 ⁻⁹ (20°C)
Chrysene	228.29	White crystals. Orthorhombic bipyramidal plates from benzene.	448	1.274	0.621	5.23x10 ⁻⁶	5.37	5.81	0.002	6.23 x10 ⁻⁹ (25°C)
Dibenz(a,h)anthracene	278.36	White, monoclinic or orthohombic crystals or leaflets.	524	1.282	0.518	1.47x10 ⁻⁶	6.25	5.97	2.49x10 ⁻³	2.78 x 10 ⁻¹² (25°C)
Fluoranthene	202.26	Colorless to light yellow crystals.	384	1.252 (0°C)	0.63	1.61x10 ⁻⁵	4.69	5.22	0.265	5.0 x 10 ⁻⁶ (25°C)
Fluorene	166.22	Small white leaflets or flakes. Fluorescent when impure.	298	1.203 (0°C)	0.788	6.3x10 ⁻⁵	3.88	4.18	1.98	1.64 x 10 ⁻⁴ (33°C)
Indeno(1,2,3-cd)pyrene	276.34	Solid	536	NA	0.566	1.6x10 ⁻⁶	6.54	5.97	6.2x10 ⁻²	1.01 x 10 ⁻¹⁰ (25°C)
Phenanthrene	178.24	Colorless, monoclinic crystals with a faint, aromatic odor.	341.2	1.179 (25°C)	0.57	3.39x10 ⁻⁵	4.19	4.45	1.29	4.2 x 10 ⁻⁴ (25°C)
Pyrene	202.26	Colorless solid (tetracene impurities impart a yellow color) or monoclinic prisms crystallized from alcohol. Solutions have a slight blue fluorescence.	393	1.271 (23°C)	0.724	1.09x10 ⁻⁵	4.83	5.18	0.135	6.85 x 10 ⁻⁷ (25°C)
Phenols and Phthalates										
2,4-Dimethyl phenol	122.17	Colorless crystals to yellow-brown liquid.	210.9	0.965	0.869	9.51x10 ⁻⁷	2.86	2.3	7870	0.102 (25°C)
2-Methylphenol (o-Cresol)	108.14	Colorless to pale brown crystals. Hygroscopic, light sensitive.	191	1.048	0.83	1.2x10 ⁻⁶	2.65	1.95	2.59 x 10 ⁴	0.299 (25°C)
3-Methylphenol (m-Cresol)	108.14	Colorless to yellowish liquid. Light sensitive, hygroscopic.	202.2	1.034	1	8.56x10 ⁻⁷	2.64	1.96	2.27 x 10 ⁴	0.11 (25°C)
4-Methylphenol (p-Cresol)	108.14	Colorless to pink crystals. Light sensitive, hygroscopic, combustible.	201.8	1.034	1	1.0x10 ⁻⁶	2.64	1.94	2.15 x 10 ⁴	0.11 (25°C)
Phenol	94.11	Colorless to pink solid or thick liquid with sweet tarry odor detectable at 0.06	181.7	1.07	0.91	3.33x10 ⁻⁷	2.43	1.46	8.28 x 10 ⁴	0.35 (25°C)
Bis (2-Ethylhexyl) phthalate	390.56	Colorless, oily liquid with almost no odor.	386.9	0.973	0.366	2.7x10 ⁻⁷	5.22	7.6	0.27	1.42 x10 ⁻⁷ (25°C)
Diethyl phthalate	222.2	Clear, colorless, oily liquid.	298	1.118	0.635	6.1x10 ⁻⁷	2.10	2.42	1080	2.1 x10 ⁻³ (25°C)
Dimethyl phthalate	194.2	Colorless, oily liquid with a slight ether odor.	283.7	1.19	0.629	1.97x10 ⁻⁷	1.57	1.6	4000	3.08 x10 ⁻³ (25°C)
Di-n-octyl phthalate	390.56	Light colored, oily liquid.	220	0.978	0.358	2.57x10 ⁻⁷	5.29	8.1	0.022	1.0 x10 ⁻⁷ (25°C)
Other										
Benzoic acid	122.12	White powder.	249	1.08	0.797	3.81x10 ⁻⁸	1.16	1.87	3400	7.0 x10 ⁻⁴ (25°C)
2-Methylnaphthalene	142.2	Solid crystals	241.052	1.0058 (20°C)	0.736	3.18x10 ⁻⁴	3.92	4.11	25.4	5.1 x 10 ⁻² (25°C)
Naphthalene	128.17	Colorless to brown solid with an odor of mothballs. Hygroscopic.	218	0.997	0.75	4.4x10 ⁻⁴	3.26	3.3	31	8.5 x10 ⁻² (25°C)
Notes: Data obtained from one of the following sources: "Groundwater Chemicals Desk Reference" (Montgomery, 1996), USEPA Soil Screening Guidance (July 1996), Pennsylvania DEP (2001), <www.chemfinder.com>. ° C = degrees Celsius g/cm ³ = grams per cubic centimeter cm ² /sec = square centimeters per second (atm-m ³)/mole = atmosphere-cubic meter per mole log K _{oc} = Soil sorption coefficient log K _{ow} = Octanol/water partition coefficient mg/l = milligrams per liter mmHg = millimeters of mercury NA = Not available.										

FIGURE 6-1a

CONCENTRATIONS OF VOCs/SVOCs IN GROUNDWATER OVER TIME - FORMER DRUM DISPOSAL AREA
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts

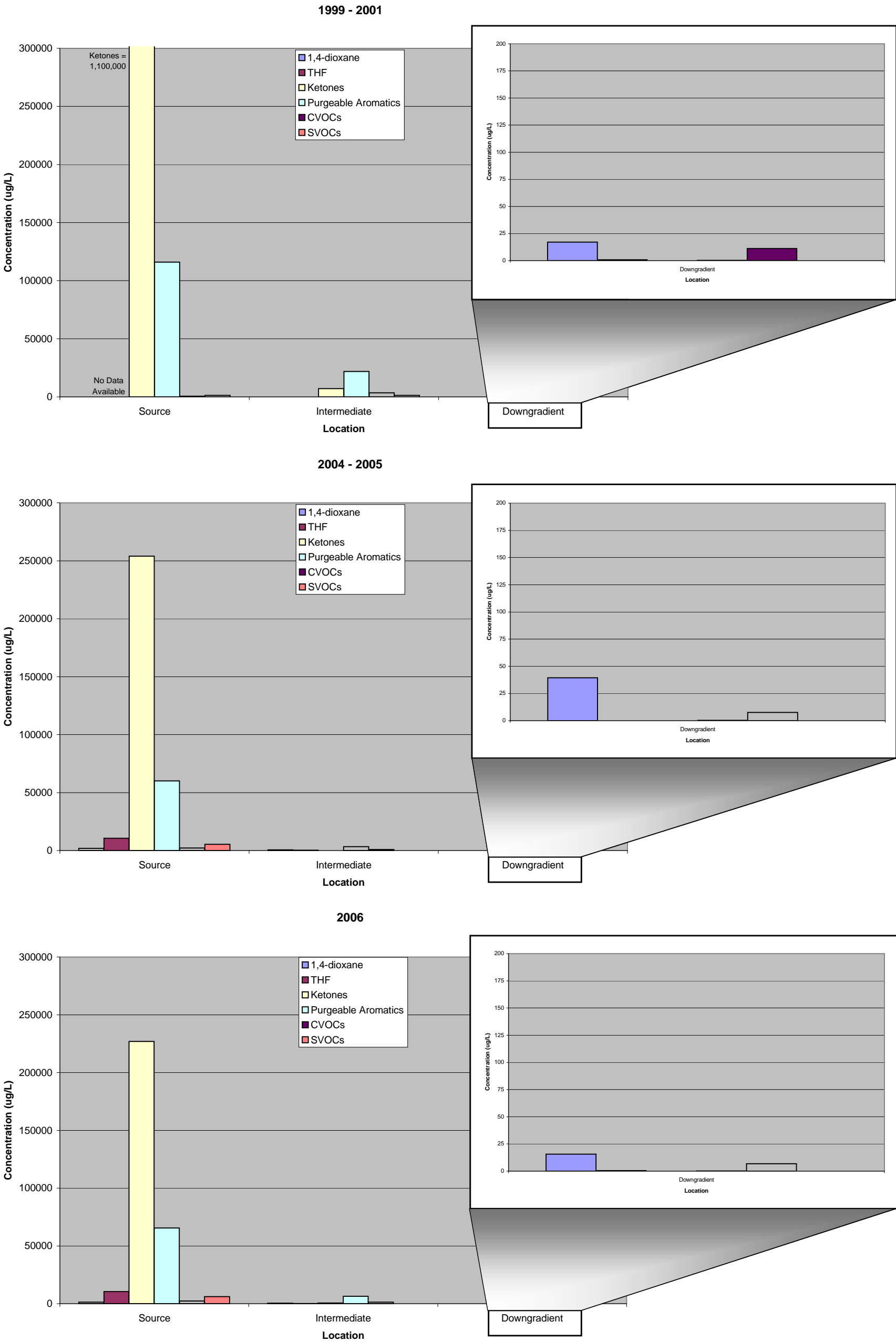
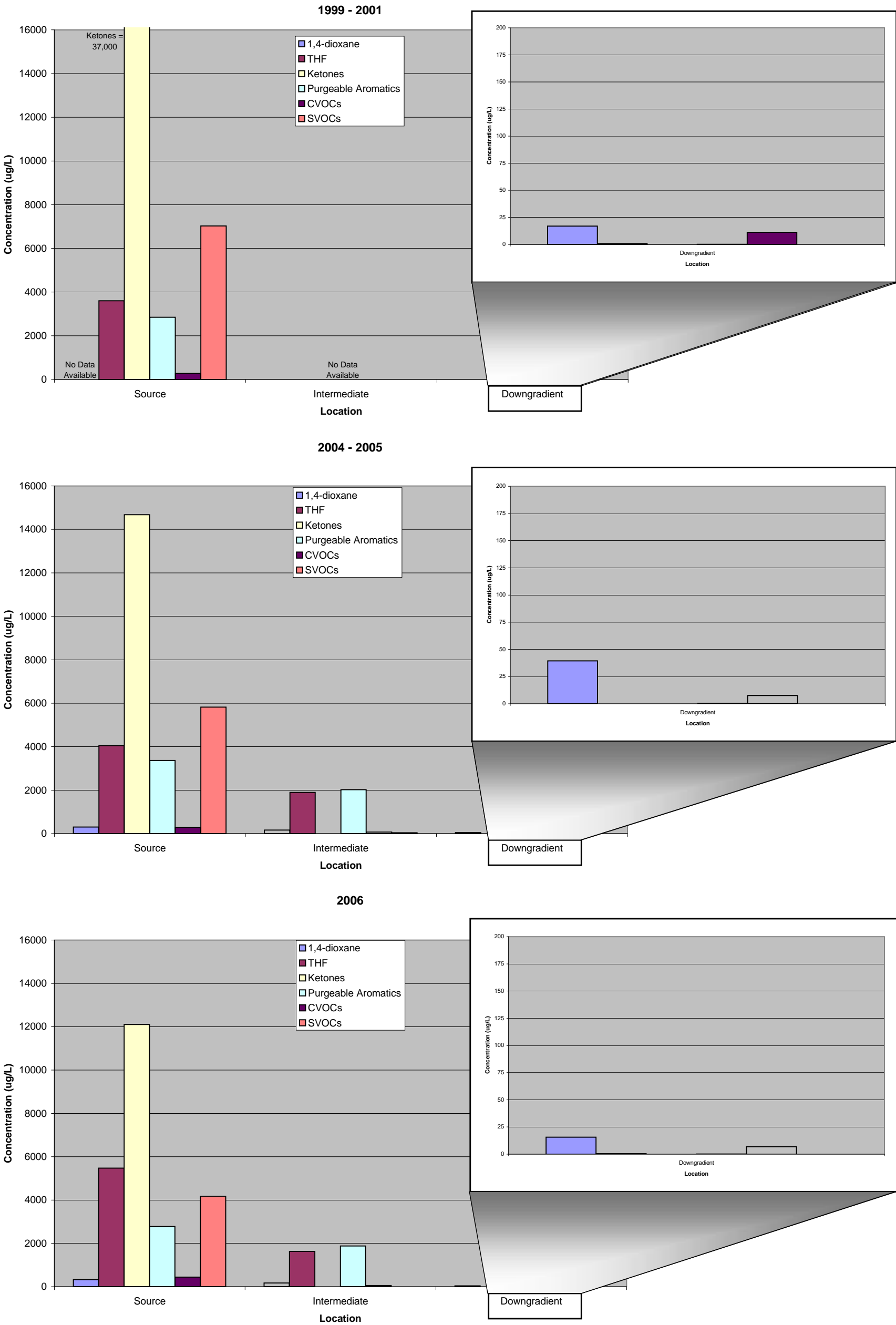


FIGURE 6-1b

CONCENTRATIONS OF VOCs/SVOCs IN GROUNDWATER OVER TIME - SOUTHERN LOBE
Remedial Investigation and Feasibility Study
Sutton Brook Disposal Area Superfund Site - Tewksbury, Massachusetts



NOTES:

- Wells utilized in the above analysis include: Source = MW-4S and MW-5; Intermediate = MW-22M; and Downgradient = MW-13D, MW-14, MW-16D, MW-17D, and GP-24.
- Compounds utilized in the above analysis include:
 - 1,4-dioxane
 - Tetrahydrofuran (THF)
 - Ketones = 2-Butanone and 4-Methyl-2-Pentanone
 - Purgeable Aromatics = 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, Benzene, Ethylbenzene, Toluene, Xylenes, n-Butylbenzene, and n-Propylbenzene
 - Chlorinated VOCs (CVOCs) = 1,1,1-Trichloroethane, 1,1,2-Trichloroethane, 1,1-Dichloroethane, 1,1-Dichloroethene, 1,2-Dichloroethane, 1,2-Dichloroethene (Total), 1,2-Dichloropropane, Chloroethane, cis-1,2-Dichloroethene, Tetrachloroethene, Trichloroethene, and Vinyl Chloride.
 - Semi-Volatiles (SVOCs) = 2,4-Dimethylphenol, 2-Methylphenol, 3-Methylphenol/4-Methylphenol, 4-Methylphenol, Bis(2-Ethylhexyl)phthalate, Diethyl phthalate, Dimethyl Phthalate, Di-n-butylphthalate, Naphthalene, and Phenol.



7. SUMMARY OF RI FINDINGS

The Sutton Brook PRP Group has entered into an Administrative Order by Consent (the Order) with the EPA to perform a RI and FS at the Site. The Sutton Brook Disposal Area, also referred to as Rocco's Landfill, is located off South Street on the eastern boundary of the Town of Tewksbury, Middlesex County, Massachusetts. A small portion of the Site also extends into the Town of Wilmington.

The specific objectives of the RI are to:

- evaluate the source(s), nature, extent, and distribution of site-related contaminants released;
- provide sufficient information to assess the current and future potential risks to human health and the environment; and
- since capping of the landfill is presumed, provide sufficient information to evaluate a capping system, including innovative technologies and the evaluation of the physical layout of Sutton Brook.

7.1 DATA COLLECTION AND DATA QUALITY ASSESSMENT

The data collected at the Site and surrounding areas and to be used in the Remedial Investigation is comprised of both previous site investigations and the recently completed Phase 1A and Phase 1B Remedial Investigations. These data encompass sampling and investigation activities performed from 1989 to 2006 (together referred to as the RI).

The recent RI field activities (i.e., 2004 and 2006) consisted of activities related to the following tasks:

- Site Survey (elevation and location surveys of investigation points)
- Soils and Sources of Contaminants Investigation (soil borings, surficial soil sampling, and test pit excavations)
- Subsurface and Hydrogeological Investigation (installing temporary and permanent monitoring wells; groundwater sampling; stream piezometer installation; water level measurements; stream gauging; in situ hydraulic conductivity testing; and groundwater modeling)
- Air Quality Assessment (landfill gas sampling)
- Surface Water and Sediment Investigation (surface water, wetland soil/sediment, and sediment sampling)
- Ecological Assessment (wetland delineation; floodplain delineation; and habitat characterization)

Samples were analyzed by the off-site laboratory for VOCs, SVOCs, metals, PCBs, pesticides, and general chemistry parameters. A summary of the combined data set developed as part of this RI, which includes previous data deemed "usable" through the data review process and the recently collected data, is provided in the table below.



Table 7-1 Summary of RI Locations

Sample Media	Total Number of Locations - Previous Investigations	Total Number of Locations - Phase 1A RI, 1B RI, and pre-ROD (2004 – 2006)	Total Number of Locations
Test Pit Explorations	10	38	48
Soil Samples (Surface, Wetland, and Sub-Surface)	55	41	96
Monitoring Wells, including Temporary Wells and Piezometers	64	46	110
Groundwater Sampling Events ¹	4	8	13
Landfill Gas	3	8	11
Sediment	27	45	72
Surface Water	16	28	44
Ambient Air	7	0	7
Leachate	0	2	2

Notes: ¹ Not all monitoring wells were sampled during each sampling event.

Following analyses, the data's usability was assessed by reviewing laboratory data for each medium and assessing whether it meets the prescribed PQOs developed in the QAPP. These data have been reviewed in terms of their precision, accuracy, representativeness, completeness, and comparability (PARCC). The historic data deemed "usable" (see above) was determined to be generally consistent with QAPP requirements and suitable for use in the RI.

Based on the results of the data quality assessment, the data collected during the RI are considered to be 'suitable' for its intended use in satisfying the RI objectives. These objectives (or end uses) include evaluating the contaminant sources; determining the nature, extent, and distribution of contaminants; and assessing the current and future potential risks to human health and the environment.

7.2 ENVIRONMENTAL SETTING

The majority of the Site is unpaved and relatively flat, aside from the steeply sloped landfill lobes. Outside the landfill lobes, the Site primarily consists of wetlands including several individual wetland areas (red maple swamp/floodplain associated with Sutton Brook [greater than 50 acres]; small isolated man-made pond [approximately 2 acres]; isolated man-made areas subject to flooding [small forested wetland area and a borrow pit]; and an isolated emergent wetland area).

The overburden geology of the area is characterized by glacial features (e.g., outwash and till deposits). The site-specific unconsolidated materials underlying these surficial deposits consist primarily of sand layers (stratified drift) underlain by a till laid down on top of bedrock. Depth to rock at the Site ranges from 20 to 60 feet below ground surface (ft bgs). The mapped rock along with the rock cores obtained during the RI, indicate that two types of rock were encountered beneath the Site. A granite or granodiorite, referred to as the Andover Granite, is classified as a light to medium-gray, foliated, medium to coarse grained muscovite-biotite granite. The other rock type, gneiss, is classified as a thinly bedded to



massive amphibolite; minor biotite gneiss. A weathered zone was observed at the top of the rock followed by more competent rock with moderate fracturing.

Unlike the ground surface topography (aside from the landfills), the bedrock surface topography varies considerably across the site. A bedrock outcrop was observed on the western portion of the area adjacent to Sutton Brook. The bedrock surface generally slopes in a southerly to southwesterly direction across the site. A valley on the southwestern portion of the site was filled with glacial drift deposits creating a higher transmissive water zone (e.g., the Town's former Poplar Street wellfield).

The ground surface across the Site consists of landfill lobes or fill areas, wetland soils, or an upper sand layer. The upper sand layer (10 to 45 feet in thickness) is comprised of a brown to gray medium to fine sand with a little silt and exists across the entire site. The units underlying this layer are controlled by the depth to bedrock and the presence and thickness of a till layer. In areas of deeper bedrock, coarser sand with some gravel was encountered beneath this upper sand, as seen on the western portion of the Site.

The main hydrologic feature at the Site is Sutton Brook and associated tributaries and wetlands. Sutton Brook is a medium gradient stream that includes both moderately moving water through established banks and slower moving water through much wider and less-established channels. The stream bed is comprised of sand and gravel with some areas of muck and peat. Sutton Brook originates in an upland area north of the Site in Andover and flows southerly, turning westerly to northerly through the Site with discharge to the Shawsheen River approximately 2,500 feet northwest of South Street. As Sutton Brook traverses the Site, the character of the brook is affected by the channel width, the channel depth, the composition of the soils underlying the brook, and tributaries that contribute to the brook.

Based on the majority of the water table elevations, surface water elevations, and the stream gauging measurements, overall, the brook is a gaining stream (e.g., groundwater discharges to the brook); whereas the wetlands area and smaller tributaries experienced variable elevations ranging from gaining to losing throughout the seasons.

To characterize groundwater flow across the Site, potentiometric surveys were conducted between October 2004 and October 2006 during which water level measurements were made at the monitoring wells and surface water staff gauges installed at the site at the time of each survey. Of these events, September 2005 and October 2006 represent low water conditions at the Site, while April 2005 and May 2006 represent high water conditions. The data collected after December 2005 are the most complete potentiometric surveys due to the inclusion of the monitoring wells and well points installed during the Phase 1B RI field activities.

Depth to groundwater at the site ranges from approximately near/at ground surface to 12 feet below ground surface. In general, the water table surface (i.e., top of the groundwater surface) mimics the natural land surface topography of the area and is influenced by the streams and wetland areas. To aid in understanding regional groundwater flow conditions, a 3-dimensional groundwater flow model (MODFLOW) was developed for the area. Simulated groundwater flow north of the Site is southerly towards Sutton Brook or westerly towards the Shawsheen River. Groundwater to the east flows westerly or southerly towards Sutton Brook and an un-named tributary. Groundwater to the south flows northerly towards Sutton Brook or the Shawsheen River. Groundwater west of the site flows either northerly toward the Shawsheen River or easterly towards Sutton Brook.

Groundwater flow patterns specific to the Site are similar to regional patterns with the brook acting as the main hydrologic feature controlling shallow groundwater flow directions. During low water conditions, the hydraulic gradient decreases; however, groundwater continues to flow southwesterly towards Sutton Brook on the northern portion of the Site and northerly towards the brook on the southern portion. As indicated on the potentiometric surface maps, the brook is the main hydrologic feature controlling groundwater flow directions regardless of season. A similar groundwater flow pattern was observed in the intermediate overburden groundwater.



Based on a review of the hydraulic gradients, groundwater flow is in a predominantly horizontal direction (horizontal gradients greater than vertical gradients) with an upward flow component, where the brook and wetland areas act as discharge zones for site groundwater. The horizontal hydraulic gradient increased slightly under higher groundwater conditions. The hydraulic gradients observed at the upgradient Perkins property and residential neighborhood were steeper than those observed on the northwestern and southwestern portions of the Site. The flattest hydraulic gradient, regardless of season, was observed in the intermediate overburden aquifer (e.g., coarse sand) on the northwest portion of the Site, in the area of the Former Drum Disposal Area.

A comparison of the average hydraulic conductivity values for each of the hydrogeologic units indicates the estimated hydraulic conductivity generally decreases with depth in the overburden with the exception of the deeper coarser sand layer, where encountered. Estimated groundwater seepage velocities under water table conditions ranged from 130 to 400 feet per year and 4 to 14 feet per year in the intermediate overburden. The calculated groundwater velocities represent estimated flow rates between various monitoring wells located on the site and specific geologic units, and not the entire aquifer. In addition, the estimated groundwater flow velocities are not necessarily indicative of the rate of contaminant transport.

7.3 NATURE AND EXTENT OF CONTAMINANTS

For discussion purposes, the nature and extent of contaminants at the Site have been divided into the following areas:

- Landfill Lobes
- Former Drum Disposal Area and Adjacent Disturbed Area
- Former Residence, Garage, and Storage Area
- Sutton Brook and Associated Tributaries and Wetland Areas
- Area-Wide Groundwater

A summary of the principal RI findings for each of these areas is presented in the following sections.

7.3.1 Landfill Lobes

Of the two landfill lobes, the Northern Lobe is the largest at approximately 30 acres (1.9 million cubic yards of material), whereas the Southern Lobe comprises approximately 10 acres (0.3 million cubic yards of material). Small debris/waste piles have also been identified in five distinct areas proximate to the landfill lobes. The landfill lobes constitute the primary source areas at the Site.

The primary migration pathways for contaminants from the landfill lobes are:

- infiltration/leaching of contaminants with subsequent transport via groundwater flow;
- soil erosion and wind blown transport of contaminants that are exposed at the surface, and includes both dust and surface water runoff; and
- volatile air emissions and transport.

Landfill gases generated from the two lobes ranged from 14 to 70 % methane; 15 to 34% carbon dioxide; and 0.7 to 540 ppm total VOCs. These levels are generally consistent with other New England municipal solid waste landfills of this size. The VOCs detected at the greatest frequency in the samples were toluene, xylene, ethyl benzene, n-hexane, and dichlorofluoromethane. Potential air emissions from the uncapped landfill were evaluated by ambient air samples. Results indicated low parts per billion concentrations of several VOCs were detected in only two of the seven samples.

Based on the RI data (visual observations of the slopes; groundwater samples proximate to the lobes; surface water and sediment samples; and landfill gas and ambient air samples), groundwater migration is



the primary contaminant migration pathway associated with the lobes given: 1) the uncapped/uncontained nature of the landfill does not limit infiltration and subsequent leaching; 2) wastes are most likely located at or near the water table surface; 3) the proximity of Sutton Brook to the landfill lobes; 4) typical landfill gas levels in the subsurface and low to non-detect concentrations of VOCs in ambient air indicating minimal mass transport; and 5) the majority of the material in the lobes is covered on the ground surface with soil and/or vegetation, thereby reducing transport by runoff.

The primary constituents detected in groundwater samples were VOCs and metals. The highest concentrations of VOCs were detected in the groundwater collected from monitoring wells located adjacent to the northern sides of the Southern Lobe. Total VOC concentrations in these wells ranged from 3,450 to 57,210 ug/l. The VOC generally detected at the highest concentration in the wells was toluene. Groundwater data from the wells along the perimeter of the Northern Lobe were much lower in concentration (total VOCs ranged from 53 to 842 ug/l). Unlike the Southern Lobe, the VOC generally detected at the highest concentration in the wells was either 1,4-dioxane or tetrahydrofuran.

The overall distribution of the total VOCs in groundwater supports groundwater flow directions with flow in the direction of Sutton Brook.

Similar constituents to those detected in groundwater were also detected in leachate samples and in surface water and sediment samples. The samples with the highest concentrations were detected in the stretch of Sutton Brook between the two lobes.

7.3.2 Former Drum Disposal Area

A removal action was conducted in this area by EPA in 2000, in which approximately 300 to 400 crushed drums were excavated and 13,786 tons of soil was transported off-site for disposal. Post-excavation data indicates that residual levels of VOCs (TCE, toluene, PCE, ethyl benzene, trimethylbenzenes, and xylenes) are present in soils with toluene, ethyl benzene, and xylenes exhibiting the highest concentrations and greatest frequency of detection. The highest total VOC concentration was detected in samples located on the southeast portion of the area. This area (southeast portion) also corresponds to an area of elevated SVOCs, specifically bis(2-ethylhexyl)phthalate, di-n-octylphthalate, and naphthalene and the area where more of the drums were formerly located.

The primary migration pathways for these residual contaminants are infiltration/leaching with subsequent transport via groundwater flow. In addition, soil erosion and volatile air emissions are potential migration pathways for contaminants that may be exposed or migrate to the surface. However, the highest concentrations of contaminants are not located at the ground surface.

As described above, groundwater and surface water runoff from this source area is toward Sutton Brook and the downgradient wetlands. Migration of volatiles in soil vapor is limited because the groundwater is at the land surface across most of this area, thereby eliminating soil pore spaces.

Similar to soils, VOCs were the primary constituents detected in the groundwater samples with benzene, toluene, ethyl benzene and xylenes (BTEX) and lower concentrations of 1,1,1-TCA, TCE, and 1,1-DCA being detected at the greatest frequency. Elevated concentrations of 4-methyl-2 pentanone, 2-butanone, and phenols were also detected in groundwater proximate to the area of the former drum disposal.

The dissolved VOC concentrations in groundwater were found to be decreasing with distance from this source area. The highest concentrations of VOCs are migrating at an intermediate depth within the overburden aquifer and within a low hydraulic conductivity medium to fine sand layer. The groundwater data also indicates that impact is limited to the overburden and has not migrated into the bedrock aquifer.

As the groundwater plume approaches Sutton Brook, a portion of the plume discharges into the brook/wetlands area. This is evident from the potentiometric heads of the wells; the results of the USGS PVD Study; similar contaminant concentrations detected in shallow groundwater (wetland piezometers),



sediments, and surface water; and the lower concentrations and type(s) of VOCs in hydraulically downgradient wells.

The groundwater flow patterns and the presence of conditions amenable to natural degradation appear to be the controlling factors to the nature and extent of the groundwater contamination in this area. Groundwater on either sides of the brook and wetland areas flows east or west, respectively towards the brook and wetlands. There is also a northerly component flow that parallels the flow of the brook. This flow regime results in a net northerly groundwater flow pattern in this area. The horizontal hydraulic gradients are relatively flat, especially in the intermediate overburden (area of higher groundwater contamination) as groundwater approaches the wetlands/brook. These low gradients and low hydraulic conductivity result in a reduced groundwater velocity and subsequent contaminant migration rates.

Based on the investigation activities conducted in the “disturbed” area adjacent to the Former Drum Disposal Area, there is not a significant source of contaminants within this area. Low concentrations of some VOCs consistently detected across the site have been detected in groundwater in this area. This area is almost totally comprised of a wetland area that was most likely created as a result of topsoil removal and equipment compaction (as evidenced by the exposed soil cuts on the limits of the area and presence of sand and gravel on the surface).

7.3.3 Former Residence, Garage, and Storage Area

This area is located on the northern portion of the Site and consists of the former residence, garage, and storage areas. The majority of the area contains surficial debris from past storage activities. Impacted soils (petroleum hydrocarbons and PAHs) are present on the south central portion of the area and most likely were caused by former storage or operation activities in this area. A subsurface fill area, comprised of wood, metal, and concrete, is present on the southern portion of the area. Groundwater is not impacted from operations within this area.

7.3.4 Sutton Brook and Associated Wetlands Areas

The main hydrologic feature at the Site is Sutton Brook and its associated tributaries and wetlands. Sutton Brook is a medium gradient stream that includes both moderately moving water through established banks and slower moving water through much wider and less-established channels. The stream bed is comprised of sand and gravel with some areas of muck and peat. Sutton Brook originates in an upland area north of the Site and flows southerly, turning westerly to northerly through the site with discharge to the Shawsheen River approximately 2,500 feet northwest of South Street.

As Sutton Brook traverses the Site, the character of the brook is affected by the channel width, the channel depth, the composition of the soils underlying the brook, and tributaries that contribute to the brook. Along its path, additional flow is discharged to Sutton Brook via three separate tributaries. One tributary flows northerly, draining a wetland area southeast of the site and discharging into the brook on the southeast side of the site. Another tributary flows northerly, draining an area south of the Site and discharging into the brook on the western portion of the Site. The third tributary flows southerly, draining a wetland area north of the site and discharging into the brook on the northwest portion of the site.

Water table and surface water elevations across the entire site were measured during the RI. Stream gauging was also performed on multiple occasions. These events aid in understanding the site groundwater-surface water flow interactions as well as any contributions from tributaries to Sutton Brook, incorporating seasonal variation. The measurements indicate that, overall, the brook is a gaining stream (e.g., groundwater discharges to the brook); whereas the wetlands area and smaller tributaries experienced variable elevations ranging from gaining to losing throughout the seasons. At times of low water (late summer and early fall), the smaller tributaries (southeast of the site and north of the site) have areas that dry up or form smaller, trickling channels through the muck or peat.



Outside the landfill lobes, the Site primarily consists of wetlands including several individual wetland areas (red maple swamp/floodplain associated with Sutton Brook [greater than 50 acres]; small isolated man-made pond [approximately 2 acres]; isolated man-made areas subject to flooding [small forested wetland area and a borrow pit]; and an isolated emergent wetland area).

The area south of the Southern Lobe is located on the southern portion of the Site and is mainly comprised of a shallow pond and dirt trails routinely used by recreational vehicles. The pond appears man-made given the presence of a berm along the pond's edge and exposed sand substrates, which suggest past excavation activities. Based on the surface water and sediment sample results, there does not appear to be an impact to the pond from site operations.

Another feature within this area is an isolated forested wetland located northeast of the pond and adjacent to the Southern Lobe. Portions of this area also appears to be man-made as a result of past excavation activities. Samples collected within this area indicate that the area has been impacted by VOCs, SVOCs, and metals.

The highest concentrations of constituents (primarily VOCs and metals) were detected in surface water and sediment samples from the brook in the reach that traverses closest to the landfill lobes. The RI data indicates that there are two primary contaminant plumes in groundwater beneath the Site. The sources of these plumes are the Former Drum Disposal Area and the Southern Lobe. As contaminants within these plumes migrate away from the source area, these plumes discharge into the wetland area and the brook. The results of the surface water and sediment sampling (PVD and laboratory analytical) within the brook and wetland areas correlate well with groundwater contamination and groundwater plume discharge areas. Contaminants (VOCs, SVOCs, and metals) were also detected in surface water, sediment, and shallow groundwater in the wetland area/marsh located adjacent to the southern side of the Southern Lobe.

7.3.5 Area-Wide Groundwater

As discussed above, the primary impacted media and migration pathway from the source areas is groundwater. Other affected media include sediment and wetland soils; however, these affected areas are localized.

Based on a review of the analytical data collected from groundwater, the primary constituents detected in site groundwater are VOCs, metals, and SVOCs. The most frequently detected VOCs and those detected at the higher concentrations in groundwater were: xylenes, toluene, ethylbenzene, 1,4-dioxane, and tetrahydrofuran. Other more frequently detected VOCs were generally detected at lower concentrations (1,1-dichloroethane and benzene) and some of the VOCs detected at higher concentrations (4-methyl-2-pentanone and 2-butanone) were not widely distributed in groundwater across the Site.

The detected inorganic constituents in area wide groundwater were arsenic, nickel, aluminum, zinc, cobalt, vanadium, beryllium, chromium, cadmium, copper, lead, silver, cyanide, thallium, antimony and mercury (in descending order of frequency detected). For relative comparison purposes, metals concentrations were compared to maximum contaminant levels (MCLs). This comparison indicated that total arsenic was the most predominant metal detected in excess of the applicable MCL.

The predominant SVOCs detected in groundwater across the site were phenols (2,4-dimethylphenol, 2-methylphenol, 3-methylphenol/4-methylphenol, 4-methylphenol, and phenol) and phthalates (primarily diethyl phthalate).

The predominant factors that will ultimately control the migration pathways of the contaminant plumes are the hydrogeologic environment, the location and characteristics of the source areas, and the partitioning/migration characteristics of the specific contaminants comprising the plume. Based on the characteristics of the source areas, fate and transport characteristics of the predominant contaminants, and the site-specific hydrogeologic environment, advection, dispersion, and natural degradation/attenuation



are the primary characteristics controlling the migration of the dissolved VOC plumes away from the source areas in groundwater.

Plume configurations depict the Southern Lobe and the Former Drum Disposal Area as the primary source areas for these contaminant plumes at the Site. The purgeable aromatic hydrocarbons and tetrahydrofuran plumes are similar in configuration; whereas the 1,4-dioxane plume is more widespread, detected at lower concentrations, and suggests contribution from both landfill lobes. This may be attributable to 1,4-dioxane being more soluble and less degradable than the aromatic hydrocarbons. The plume configurations also show that the plumes are generally contained within the immediate boundaries of the Site (i.e., plume configurations are controlled by groundwater flow, discharge to the brook and associated wetlands, along with degradation/attenuation mechanisms).

Similar to the VOC contaminant plumes, the highest concentrations of total arsenic are present in the areas immediately adjacent to the source areas. However, unlike the VOC plumes, arsenic concentrations in groundwater in excess of MCLs are also detected in upgradient wells; indicating that, arsenic concentrations may be naturally occurring at “elevated” levels (e.g., concentrations that exceed the drinking water standards).

As groundwater flows through the source areas, the constituents partition into the groundwater and migrate with groundwater flow away from the source areas forming a dissolved plume. The predominant mechanism for migration of the plume away from the source area is through advection. In the area of the Southern Lobe, it appears that groundwater (based on potentiometric head data) and the dissolved VOCs (based on concentrations detected in monitoring wells) initially migrates away from the source area in a predominantly northeasterly to northerly direction. In the area of the Former Drum Disposal Area, the dissolved VOCs initially migrate in a southwesterly to westerly direction towards Sutton Brook and the associated wetlands.

Once both plumes reach the general vicinity of the brook/wetlands, the plumes merge with regional groundwater flow and travel in a predominantly northerly flow direction. Based on hydraulic gradients, the dissolved VOC plume predominantly migrates in the horizontal direction with a slight upward component of flow as the plume approaches the brook/wetlands.

Simulated regional groundwater flow patterns within the area (based on the site-specific groundwater flow model) in relation to these plumes indicates groundwater flow patterns correlate well with the contaminant plume configurations. These flow directions also suggest that groundwater flow further downgradient of the Site would be predominantly along the reaches of Sutton Brook and that due to the configuration of surface water bodies (Sutton Brook, Shawsheen River, and associated tributaries) the majority of the surrounding areas, including the residential neighborhoods, are located hydraulically upgradient of the Site and therefore, in general, the groundwater plumes migrate toward and discharge to Sutton Brook and associated wetlands along the brook.

The higher VOC concentrations are detected in the intermediate overburden. Hydraulic gradients in this zone of the aquifer are relatively flat (0.001 ft/ft range) and combined with low hydraulic conductivities result in a reduced groundwater velocity and subsequent reduced contamination migration rates.

No significant increasing trends in concentrations of dissolved VOCs or SVOCs or significant changes in the shape of the dissolved VOC plumes have been detected at the site throughout the sampling events. Although a significant amount of new groundwater data has been recently collected, the extent and concentration distribution of the plume on the site appears to be generally consistent throughout the past ten years of sampling (dating back to 1995). Additionally, decreasing contaminants trends in VOCs are apparent especially for the VOC contaminant mass across the site.

The analytical and geochemical data indicate that natural attenuation processes have and continue to effectively degrade and reduce the mass of site contaminants. These natural attenuation processes,



including biodegradation, dispersion, dilution, sorption, volatilization and chemical or biological stabilization, transformation, or destruction, have and continue to effectively stabilize and/or decrease the size of the contaminant plume. In addition, chemical footprint indicators, including the absence of electron acceptors oxygen, nitrate and sulfate and the presence (and subsequent increase spatially on-site) of metabolic byproducts methane and ferrous iron have been measured within and immediately downgradient of source areas on-site, indicating that biodegradation processes are interacting with contaminants in groundwater.

A review of the results of the RI indicate that sufficient information has been collected to evaluate the source(s), nature, extent, and distribution of contaminants and to assess the current and future potential risks to human health and to the environment.



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